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Public Lighting

Practical Experiments on the Standard Specification

IN this number we are giving an account of the Fifth Annual Conference of the Association of Public Lighting Engineers, which was held in Sheffield during July 9th-12th. The conference was attended by a number of leading members of the Illuminating Engineering Society and by representatives of the B.E.S.A. Committee on Street Lighting, to whom the practical demonstrations of methods of complying with the British Standard Specification were naturally of special interest. It was undoubtedly the most successful conference which the Association has yet held, and reflected great credit on all those who were responsible for the preliminary arrangements, amongst whom the new President (Mr. J. F. Colquhoun) and the Secretary (Capt. W. J. Liberty) deserve special mention.

There were, as usual, several representative papers, namely, those by Mr. J. M. Waldram on Visibility, by Councillor Thraves on Practical Requirements in Public Lighting, and by Messrs. E. H. Horstmann and F. E. Sharp on Non-Manual Control of Public Lamps. The outstanding item, however, was the excellent display of lighting fittings, in which practically all the leading modern types were represented, distributed over approximately eight miles of streets. A list of these 50 experimental installations is reproduced on page 221. Visitors were taken on tour round the lighted streets, and had ample opportunities of judging their effect. They were also invited to participate in a series of tests, chiefly directed to judgments of glare, the records being inscribed on appropriate cards specially prepared for the purpose. These data should ultimately afford much useful information, although inevitably many of those who took part were new to tests of this kind, and were called upon to continue their efforts into the small hours of the morning, when some degree of visual fatigue must have impeded their efforts! However, these somewhat exacting tests were entered upon with enthusiasm. Special recognition should be given to the efforts of Dr. Walsh and Mr. Stiles (of the N.P.L.) and their band of assistants, who organized these tests and acted first as observers and then as instructors to others—a service which entailed not one but a succession of nights of work which only ceased at dawn!

It would be premature as yet to try to assess the general bearing of these experiments on the specification. This will doubtless be the task of the Committee of the B.E.S.A., which has already devoted so much time and effort to this complicated problem. One was, however, struck by several salient points, such as the evident difficulty of devising installations to comply with the higher classes of the specification, and the considerable part played by glare in most cases where an attempt is made to secure approximately uniform distribution of light. There was only one instance of a Class B installation. Class A, which calls for a minimum of 2.0 foot-candles, admittedly demands a "super-illumination," such as is unlikely at present to be met with in many cities.

For the rest, the experiments suggest that the committee acted wisely in not attempting to limit the diversity factor—a point which was illustrated in Mr. Waldram's informative paper, pointing out the wide variations in *brightness*, as compared with illumination, which occur with the polished road surfaces now usual. There is now a distinct tendency to attach less importance to the provision of very uniform illumination, a process which inevitably involves accentuating the candle-power at angles slightly below the horizontal, and therefore leads to glare. It is, however, essential that the grading of illumination should be gradual, i.e., there should be no sudden transitions from low to relatively high illuminations.

Such conferences as this serve a double purpose—for propaganda, and educational. It was encouraging to note the keen interest taken by the Sheffield authorities in the lighting of their city, and the well-deserved tribute paid by Councillor R. H. Minshall, Councillor F. Thraves and others to the efforts of their lighting engineer, Mr. Colquhoun. This must have an inspiring influence on other cities. Equally valuable was the opportunity afforded to the experts to exchange views. Apart from the proceedings at the actual meetings at the Town Hall there were long-drawn and animated discussions at the Grand Hotel and elsewhere—which is just what is needed to enable the possibilities and limitations of the specification to become generally understood.

In conclusion, a word should be said regarding the very hospitable manner in which delegates were entertained, and the various pleasant social features of the gathering.

On the Relief of Eyestrain Among Persons Performing Very Fine Work

AN instructive report on the above subject (No. 49), by Messrs. H. C. Weston and S. Adams, has recently been issued by the Industrial Fatigue Research Board*. Readers will recall the previous report of the same observers on the effect of eyestrain on the output of linkers in the hosiery industry. The present report, which extends the inquiry to other processes, including the mounting of lamp filaments and various fine processes in the textile industry, confirms the great importance of magnifying glasses in cases of very fine work. In the introduction to this report the effort required to see objects which are clearly visible only when the eye is fully accommodated is likened to that of lifting a weight which can only just be raised when the maximum effort of the group of muscles concerned is used. If this effort has to be repeated frequently the onset of fatigue is rapid, and the frequency of the idle periods essential for recovery will reduce the total work done in a given time, as compared with that possible by the use of a smaller but more continuous effort. This is equally true of the eyes. If maximum accommodation is required they must be rested frequently by looking at more distant objects. But if the degree of accommodation necessary can be reduced such pauses may be diminished and the visual attention given to the work facilitated.

The use of glasses is necessary not merely to correct defects of vision but for the purpose of reducing the accommodation and convergence of the normal eye and diminishing the strain of work. It is recommended that such glasses should be tried whenever the details of adequately illuminated work cannot be clearly seen unless the eyes are brought within a distance of 10 inches from it. Experience of their use seems to be quite favourable. All the workers, after wearing the glasses for a few days, agreed that they were deriving some benefit and, in general, the relief afforded enabled the rate of output to be materially increased. The amount of this increase varies from 8 to 26 per cent. for drawing-in, and from less than 1 per cent., in an exceptional case, to 20 per cent. for filament sorting and mounting. These figures, moreover, refer only to experienced workers. There is evidence that a still greater increase may be expected in the case of a learner. On the whole, a conclusion is reached similar to that derived from the previous investigation on hosiery linking—that an average increase of the order of 12 per cent. may be expected.

So far only a few of these very fine processes have been studied, but there must be many other operations to which the same conclusion may apply. To illuminating engineers this point is of vital importance. It illustrates the fact that if the eye (either owing to inherent defects or to fatigue arising from exceptional strain) is unable to maintain the requisite effort of accommodation, the observer is unable to see fine detail, even if the conditions of illumination are entirely adequate. Cases in which the lighting is unjustly blamed, when it is really the mechanism of vision that is at fault, are not infrequent. No doubt the time expended in recuperative pauses would be even greater if the illumination is faulty. In all cases of fine work illuminating engineers should satisfy themselves that the illumination is adequate, and that there is no glare nor troublesome shadows arising from incorrect direction of light. But they would also be well advised to bear in mind that magnifying glasses may be necessary and that the advice of an oculist may also prove to be of service to the employer.

The whole investigation illustrates a vital point, which experts on lighting are still prone to overlook —the part played by the peculiarities of the eye in many problems of illumination. These peculiarities make themselves felt in all cases involving sustained near vision, which is in itself an abnormal condition. Another instance is afforded by the effect of the closing of the pupil-aperture, which diminishes the amount of light entering the eye, but may actually improve the vision of eyes having lens defects, serving the same purpose as the stop on a camera. This effect doubtless explains the strange preference of some people for working under "glaring" conditions; for the glare has the effect of closing the pupil aperture and improving the powers of the precision of the lens.

* Published by H.M. Stationery Office (Adastral House, Kingsway, London, W.C.2; 1s. 3d. net).

Accidents in the Streets

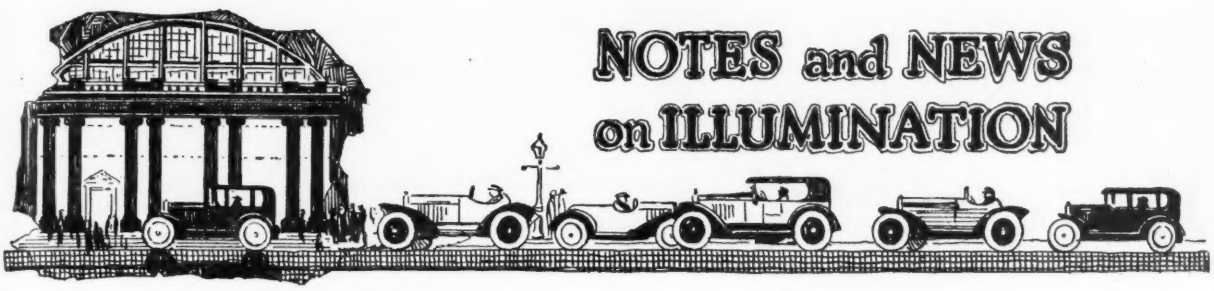
WE have before us the usual annual official record of "Street Accidents Caused by Vehicles" for the past year. The total number of persons killed or injured in England and Wales was 139,831. This number still shows an increase over the corresponding figure for 1926 (126,090), and it is significant that a considerable proportion, viz., 49,105 casualties, occurred in the Metropolitan police area alone, where the population is approximately 7½ million. Huge as these figures appear, it is some consolation that the rate of increase has tended to become stationary during recent years, in spite of the fact that the number of vehicles on the road is constantly increasing. There is also evidence that the campaign waged by the Safety-First Council has had a beneficial influence. Thus, in London, where the Safety-First Council has made special efforts on behalf of children, 12 fewer children were killed than in the previous year; and we understand that in Edinburgh, where there is also an active Safety-First Council, there were actually fewer accidents of all kinds than in 1926.

The form in which these statistics are presented does not enable any discrimination to be made between accidents occurring respectively by night and by day, but we have previously shown that such data as do exist on this point support the contention that lighting is an influential factor.

We recall that the late Mr. Gaster repeatedly urged the need for fuller statistics on this point, suggesting that every fatal traffic accident in the streets of London should be made the subject of an official inquiry (as is the case on the railways), and that all relevant factors, including lighting, should be studied.

There are also numerous steps that have recently been taken to facilitate safety of traffic, such as the guiding "white line," which are of considerable interest to illuminating engineers.

Another device is the now familiar "Cross Here" sign, which has doubtless helped considerably towards the elimination of accidents to children. We observe that Dr. F. J. Waldo, senior coroner for London, in a recent report has expressed strong approval of such signs. As a matter of principle, such signs should be illuminated at night in the manner which is now becoming usual for other forms of traffic signs. There is evidence that light is destined to play an ever-increasing part in the guidance and regulation of traffic, and any measures which promote this are helpful in this respect, and will also tend towards the elimination of street accidents.



The National Physical Laboratory

The annual visit to the National Physical Laboratory on June 26th seemed to attract more visitors than ever, despite the occasional showers. One thing that undoubtedly adds to the pleasure of the visit is the fact that the laboratory is situated amidst such charming surroundings. The beautiful stretch of turf was in fine condition, and the bed of delphiniums near the entrance once more attracted attention. The programme of experiments and exhibits, comprising 226 main items, was very varied, and illustrated the wide range of work now carried on at the laboratory. Our own attention was concentrated chiefly on the photometric department, where we had the opportunity of examining the large integrating photometer installed and discussing the problems involved in the testing of asymmetric sources. There was also on view a complete precision photo-electric photometer, based on a bridge method, with which useful work is being done, though the difficulties involved in the use of such apparatus are not underestimated at the National Physical Laboratory. The outstanding advantage of photo-electric methods seems to be that by this means one can detect variations in brightness which could hardly be definitely ascertained by ordinary photometric devices. There was also on view an ingenious demonstration of the properties of a selenium cell—light falling on the cell being received through one of a series of apertures in a rotating disc so that the visitor, by applying the cell to different apertures corresponding with different frequencies, found himself able to play a tune! In other sections of the laboratory methods of determining the effect of glare, tests of daylight illumination, and experiments on the reflecting power of road-surface materials were being shown.

Industrial Fatigue Research Board

EIGHTH ANNUAL REPORT.

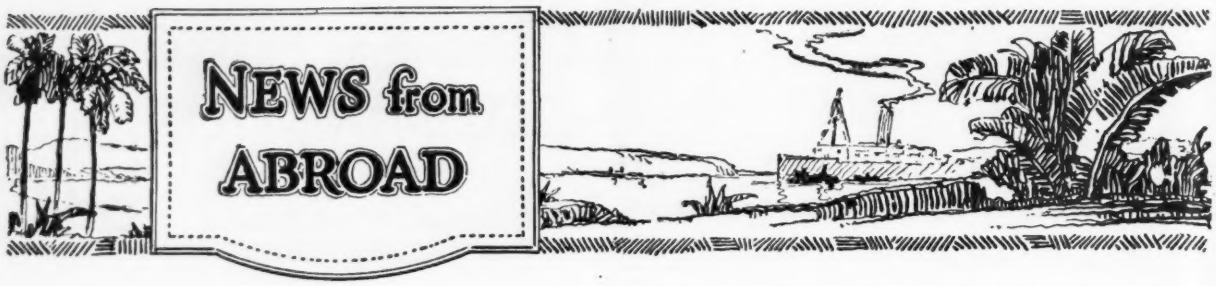
The Eighth Annual Report of the Industrial Fatigue Research Board gives a good insight into the excellent work that has been done for nearly 10 years by this useful body. Readers will be aware of several researches on illumination in which the Board participated, notably the researches of investigations of Messrs. H. C. Weston and A. K. Taylor on the relation between illumination and efficiency in fine work. This general enquiry led to the investigation of lighting conditions in printing works. Equally useful has been the study of the deterioration of vision through the performance of fine work—a problem that is now being dealt with by Dr. W. S. Duke Elder at the London School of Printing. But the work covers a very wide field. Many other enquiries on subjects quite unrelated to lighting and vision are mentioned, such as those on the Physiology of Ventilation, Vocational Guidance and Selection, and enquiries into the origin of various special industrial disabilities (sickness of weavers, telegraphists' cramp, etc.). One interesting problem is the extent to which intensive training in one activity affects the acquisition of skill in other directions. The work of the Board has already had a useful influence in showing that the workers' well-being is not antagonistic to production, and that maximum production is contingent on maximum fitness of the worker. A belief in the favourable influence of spells of rest on production is fully supported by the results of investigations, and there are cases of severe manual labour in which this fact was discovered long ago by the crude process of trial and error.

Daylight and Sunlight

We notice in *The Illustrated Carpenter and Builder* a contribution from Mr. Percy L. Marks dealing with the natural lighting of buildings. Mr. Marks quotes the old rule, apparently over 100 years old, to the effect that one square foot of glass should be allowed for every 70 cubic feet of space in the apartment. This is admittedly only a very rough and ready rule. To mention only one other consideration, there is the question of the height of the glass above the working plane—the upper portion of windows is relatively much more valuable for purposes of illumination. In the same journal we observe some comments on the contributions in the recent Sunlight and Health issue of *The Times*. An architectural correspondent has suggested a new criterion of progress in architecture—the skill attained in devising traps for sunlight. Whilst most of us will agree as to the vital importance of adequate access of daylight, we agree with the comment of Mr. Marks that even here we need to guard against glare. Diffused daylight is valuable, but is the entrance of sunlight an unmixed blessing? It is approved by enthusiastic advocates of the benefits of ultra-violet rays, but those who have tried to work in a room flooded by sunlight will have found it rather a nuisance. Direct sunbeams are, in fact, undesirable from the standpoint of working illumination, and where the sun does enter diffusing blinds are usually necessary during working hours. On the other hand, advocates of the health-giving powers of the sun may find comfort in the reflection that in summer the light from the blue sky and even diffused daylight are by no means destitute of ultra-violet rays, and there is no reason why these should not be utilized.

Landscape Rooms

The same journal contains an attractive article by Mr. John M. Fife, who recalls the practice, which originated in Italy, of designing "landscape rooms"—decorated to represent charming views of nature, so that even in winter the occupant may revel in pictures of lakes, trees and meadows bathed in summer sunshine. A few examples of such apartments are to be found in England — Cross Deep, Twickenham; Hall's Croft, Stratford-on-Avon; and Coombe Springs, Kingston, are cited by Mr. Fife as instances. There seems something to be said for this idea, which also finds expression in some of the latest attempts to devise "gardens" illuminated by artificial means. The effect of such scenes might be accentuated by incorporating them as an essential feature of the lighting, e.g., placing the design of luminous panels, which not only afford pleasing pictures but add something to the illumination of the room. Alternatively, the picture might be cunningly lighted by concealed floodlights so as to stand out from its surroundings, though by abandoning the use of transmitted light one loses one of the chief possibilities—the accentuation of contrast. It was recently asserted that there is a great feature for methods of illumination based on the idea of spreading the light, so that the sources become luminous panels of relatively low brightness. We should not be surprised if such methods became quite popular, especially if allied to pictorial effects. They have obvious possibilities in restaurants and places of entertainment where ample space is available for landscape-painting on a large scale.



The International Congress in the United States

The end of this month will witness the departure of the British delegates to the important international congress in the United States. We understand that the list of those from this country who will be attending the congress includes Mr. C. C. Paterson, who is this year President of the International Illumination Commission, Dr. J. W. T. Walsh (National Physical Laboratory), Mr. P. Good and Professor MacGregor Morris (Institution of Electrical Engineers), Mr. R. Watson (Institution of Gas Engineers), and Mr. W. E. Bush, Mr. G. Campbell, Mr. H. Talbot, Mr. E. Stroud, Mr. L. B. W. Jolley and others who are members of the Illuminating Engineering Society. The list should therefore be a representative one. Certainly those who attend the conference and are able to take part in the full programme will have a most interesting if somewhat strenuous time. The first item will be a comprehensive tour of outstanding lighting installations which will terminate at Toronto in time for the opening of the 22nd Annual Convention of the Illuminating Engineering Society (U.S.A.). Immediately after the Toronto Convention the meeting of the International Commission on Illumination will take place. It is hoped that some account of these experiences will be presented at the opening meeting of the Illuminating Engineering Society in this country next November. Those who participate in the tour should have much of interest to tell us regarding their experiences in the United States.

Progress in Lighting

Progress in lighting was recently summarized in a paper read by Monsieur E. Imbs, who is the President of the Société pour le Perfectionnement de l'Eclairage in Paris. The early part of the paper followed familiar ground. Monsieur Imbs explained the chief units used in illuminating engineering, and traced progress in electric illuminants from the carbon filament lamp onwards. It was pointed out in actual fact charges for electricity are less to-day than before the war, though, owing to the depreciation of the franc, the nominal rate has been approximately trebled. According to prices now ruling in Paris, 1,000 lumen-hours cost 12 francs with candles, 1.2 francs with oil, and only 0.12 francs with electricity. *Light for light*, therefore, electricity is very much cheaper than the humbler illuminants. Monsieur Imbs also explained the essential principles of "éclairagisme," a new term which may be regarded as synonymous with illuminating engineering in this country. It is characteristic of French methods that a special effort is being made to enlist the co-operation of leading architects and specialists in decoration, and we expect that many interesting and novel installations will be designed in France during the next few years.

Infra-Red Rays in Medical Treatment

The use of infra-red rays in therapeutics formed the subject of a paper read by Dr. Jean Saidman, of Paris, at the first International Conference on Light and Heat in Medicine and Surgery, held in London last year. The paper is now reproduced in *The British Journal of Actinotherapy*. So much attention is now being devoted to ultra-violet rays that the possibilities of treatment with infra-red radiation are apt to be overlooked. Such radiation has been used with good effect in Germany, though Dr. Saidman emphasizes the fact that this form of radiation, like the ultra-violet rays, should only be applied under medical guidance. Dr. Saidman briefly discussed the chief sources of infra-red energy, which is of course comparatively easy to obtain. Much remains to be done, however, in analysing the effects of various wavelengths. Here again improvement in methods of measurement is desirable. The thermopile suggests itself for this purpose, but it can only be applied satisfactorily to radiations below a certain wavelength. Wavelength apparently has an important bearing on penetration, but little is known regarding the effect of infra-red energy of very great wavelength, e.g., beyond about 10μ.

Inadequate Illumination on City Railways

One occasionally hears from correspondents abroad accounts of advances in illumination and descriptions of conditions which compare very favourably with those in this country. This applies particularly to railway stations. It is frequently affirmed that the illumination of terminal stations is carried out much better abroad than is the case here, and it is no doubt true that the lighting of some of the main stations in London is capable of improvement. It is, however, of interest to record one investigation which suggests that other countries have similar difficulties to contend with. Professor E. Friedeberger, in the *Deutsche Medizinisch Wochenschrift* (1927, No. 45, page 1911), has been calling attention to this subject. He contends that the daily journey in close, badly ventilated and overcrowded cars, with their risks of infection and fatiguing effects, must be made more comfortable. Want of illumination is the most pressing necessity. Measurements made with the Bechstein illumination-photometer during the winter months of 1926–27 in the various traffic routes of Berlin showed serious shortcomings. A few comparisons were also made on long-distance traffic.

1. In the street cars—measurements taken in the suburbs. Where illuminated signs were less abundant showed inside the cars about 20 lux*, and on the back platforms 12 lux. (As they run steadily this illumination is quite comfortable.)

2. In motor buses under similar conditions the lighting is worse. Sitting passengers have 6 to 14 lux, but with the shaking of the bus reading is only done with special effort.

3. The underground railway. The lighting is very unequal. The lamps themselves, more decorative than useful, might answer in a dwelling-house, but are out of place here. The values ran between 10 and 60 lux, due to the ill-regulated distribution and unsuitable shades. The stations are so badly lighted (5 to 15 lux) that only immediately under the lamps is sufficient light. On station seats the light is wholly insufficient, 7 lux, and on the staircase 1.7 lux. All principles of modern lighting seem to have been forgotten, and in these stations passengers are often waiting up to 20 minutes. In the newer North and South line the lighting is good and nearly shadowless.

4. The district line (Stadt bahn) has the worst lighted carriages, values of 4 lux being usual, and only one of 25 measurements reaching 16 lux. The staircases at the stations are equally dark, giving 3 or 4 lux, and directly under the lamps 8 lux. On long-distance expresses there were found in the carriages 12 to 14 lux, and in the corridors 2 to 7 lux.

* 10 lux may be regarded as roughly equivalent to 1 foot-candle.

TECHNICAL SECTION

COMPRISING

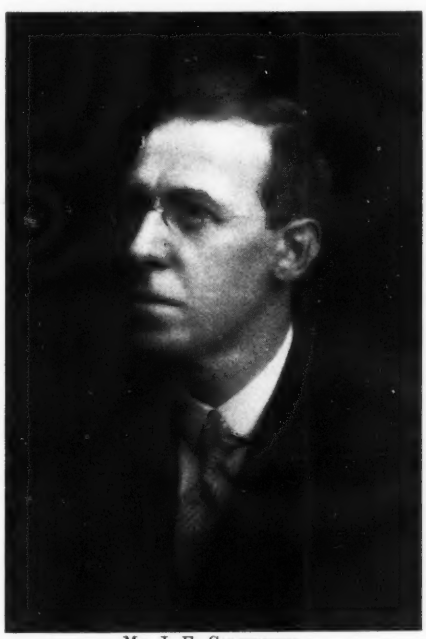
Transactions of The Illuminating Engineering Society and Special Articles

The Illuminating Engineering Society is not, as a body, responsible for the opinions expressed by individual authors or speakers.

Association of Public Lighting Engineers

Fifth Annual Conference (held in Sheffield, July 9th—12th, 1928)

THE Fifth Annual Conference of the Association of Public Lighting Engineers, which was held in Sheffield during July 9th–12th, was a most successful gathering. In opening the proceedings on the morning of July 10th, the Lord Mayor (Alderman M. Humberstone, J.P.) extended an official welcome to delegates. In the course of his address he summarized the great improvements in the lighting of Sheffield which had been made under Mr. Colquhoun's supervision, mentioning one little problem that still required attention—the lighting of various courts and alleys. After the retiring President (Mr. Alex. C. Cramb) had briefly returned thanks, Mr. J. F. Colquhoun was duly elected President for the coming session and delivered his address, which dealt with the special experimental installations in Sheffield devised to illustrate the working of the Standard Specification (see page 221), and was heard with great interest. Councillor R. H. Minshall, Chairman of the Lighting Sub-committee, endorsed all that Mr. Colquhoun had said regarding the importance of good public-street lighting, and especially his plea that a fully equipped testing laboratory should be established. Two papers, by Mr. E. H. Horstmann and Mr. E. E. Sharp respectively, were then read dealing with "Non-Manual Control of Gas and Electric Lamps," and gave rise to an interesting discussion, which was resumed on the following day.



Mr. J. F. Colquhoun.

President of the Association of Public Lighting Engineers, and Public Lighting Engineer to the City of Sheffield.

At the luncheon given by the Chairman and Directors of the Sheffield Gas Company at the Cutlers' Hall the toast of "Our Civic Authorities" was proposed in a witty speech by the Rt. Rev. the Lord Bishop of Sheffield, and responded to by the Lord Mayor of Sheffield (Alderman M. Humberstone, J.P.) and Councillor T. H. Hurst (Newcastle-upon-Tyne). The toast of "The Association of Public Lighting Engineers" was proposed by Lt.-Col. H. K. Stephenson, and Mr. J. F. Colquhoun (President) briefly responded.

The afternoon was devoted to an instructive visit to local steel works, and in the evening visitors were conveyed in motor-coaches round the extensive series of experimental street-lighting installations distributed over nearly eight miles of streets. A number of the visitors subsequently took part in the series of tests of glare, by the aid of special contrast-discs, which continued until the early hours of the morning.

On Wednesday morning, after the President and Council had placed a wreath on the Cenotaph in Barker's Pool, the discussion of the papers read on the previous day was resumed. A very practical paper entitled "What the Public Want from a Street-Lighting Department" was read by Councillor F. Thraves (Chairman of the Sheffield Watch Committee), and a subsequent paper on "Visibility" was read by Mr. J. M. Waldram. These papers also gave rise to a good discussion, after which a cordial vote was moved to the authors. On the proposition of Alderman Jos. Taylor (Bolton), seconded by Mr. Alex. C. Cramb (past President), a hearty vote of thanks was passed to the Lord Mayor and Corporation of Sheffield for the generous hospitality afforded during the visit.

Appreciation of the services of the retiring President and the Council of the Association during the past year was expressed by Mr. C. C. Paterson, Alderman Gordon (Liverpool), Councillor Adams (Edinburgh) and Councillor Minshall (Sheffield).

To these votes of thanks the Lord Mayor of Sheffield and Mr. Alex. C. Cramb briefly responded.

An invitation conveyed by Councillor Sutton, speaking on behalf of the Bournemouth Lighting Committee, to hold the next conference in Bournemouth was accepted with acclamation.

During the afternoon coaches conveyed the visitors to Buxton, where tea was provided, and the party were met by the Lord Mayor of Sheffield and the Mayor of Buxton. This trip, which was favoured by delightful weather, enabled visitors to get a glimpse of the beautiful scenery of the Peak district.

On Wednesday evening the Association Dinner, held at the Grand Hotel, was a most enjoyable event. Although many of the visitors, being recalled by duties, left with regret by Thursday morning, others were fortunately able to prolong their stay and to visit local cutlery and silverware works, the Ruskin Museum, the Mappin Art Gallery and Museum and other places of interest. Even this did not conclude the proceedings, for on Thursday evening a meeting of the Committee of the British Engineering Standards Association responsible for the framing of the Standard Specification had been arranged.

Presidential Address

By J. F. COLQUHOUN

(*Public Lighting Engineer to the City of Sheffield*).

(*Abbreviated.*)

IN the early part of his address Mr. Colquhoun referred to the fact that the Association had passed an important milestone in its existence by becoming incorporated in January last. Reference was also made to the conference on illuminated roadway signs and traffic signals, held on February 21st, when an introductory paper was read by Mr. W. J. Jones and a resolution was moved requesting the B.E.S.A. to form a representative committee to deal with the problem.

Mr. Colquhoun then turned to the chief subject of his address—the series of installations devised to illustrate the working of the Standard Specification for Street Lighting. The address was accompanied by a table giving the salient features of these installations; this table (with a few additions subsequently included by Mr. Colquhoun) is reproduced on page 221.

The photometric readings were taken under actual "service" conditions, but all possible care was taken to ensure that the lamps and burners were properly adjusted; no readings were taken during perceptible fog, and the installations have been classified in the table according to "rated" conditions.

A Holophane lumeter (street-lighting model) was used, the test plate being placed on a 1½-inch board on the ground and spirit levels used to ensure that the test plate was level. Readings are as accurate as are likely to be obtained under actual working conditions. The average of, in almost all cases, four readings is given.

Installations 2 and 3 form an interesting comparison. Installation 2 has large units erected at a considerable height and far apart. Installation 3 comes into the same class of the specification with smaller units closer together and at a lesser mounting height. While the minima illumination are almost identical (0.065 and 0.06 foot-candles) there is a considerable difference in the maxima illumination (4.0 and 2.0 foot-candles). But the increased maximum illumination in installation 2 does not add a great deal to the visibility on all parts of the street.

Installation 4 is a good example of what ought not to be done. The lamps are arranged on one side of the street only, and the installation comes within, in every respect, class H of the specification. But the result is unsatisfactory. This suggests that a modification of the specification is necessary. Perhaps it could be met by a clause giving minima mounting heights of the units on one-sided lighting *in relation to the width of the carriageway*. Further, the distance between the lamps and on which the spacing-height ratio is based is greater where the lamps are staggered than where they are placed on one side of the street only. Hence, "effective" distance, i.e., the sum of the distances from the test point to the two nearest lamps, should be taken. A comparison of installations 4 and 5 shows the great advantage with low-mounted units of staggered lighting. There is an increase on the minimum illumination in installation 5 over installation 4 of only 0.004 foot-candles, but the increase in visibility is considerable, at all events on the carriageway.

Installations 7 and 8 are identical except that No. 7 is fitted with half-clear and half-frosted globes, and No. 8 with clear globes. The ratio of minimum to maximum illumination is 1 : 18 with the half-frosted globes, as against 1 : 34 with clear globes. The minimum illumination is increased from .05 foot-candles in installation 8 to .066 in installation 7. This is largely due to the globes. The advantage of mantles being placed "in line" rather than "in circle" is shown by installation 9.

Installations 10 and 11 may be contrasted with installations 13 and 14, the former showing considerable uniformity of illumination and the latter considerable contrast. There is a difference in the appearance of installations 10 and 11. The measurements of illumination are almost equal, but the surface brightness on the roadway on installation 11 is greater than on installation 10. This may be due to difference in gradient of the roadway, or to a difference in the distribution of light. But surface brightness is not necessarily visibility, unless it is obtained by the silhouette effect when the bright surface of the roadway acts as a mirror. In installation 10 the distinction in two colours, green and brown, can be clearly seen at a distance of 57 yards when those colours are near the minimum test point. In installation 11 they cannot be distinguished beyond 32 yards. This is entirely due to the greater glare from light sources of installation 11 as compared with installation 10.

Installations 15 to 21 serve to demonstrate the higher "ratings" of the specification. Installation 24 shows an interesting adaptation of directive prismatic glassware to gas street lighting. A comparison of installation 22 with installations 25 and 26 again shows the value of gas mantles being placed "in line."

Installation 31 is of special interest. It is an endeavour to apply a form of floodlighting to street lighting. It does not conform to the specification in any particular. There are eight lamps (500-watt) in 710 feet of roadway 42 feet wide. The average spacing for normal lighting would be 97 feet between the lamps and 54 feet from the test point to the two nearest lamps. More might be made of installations 32 and 33. The minima of illumination are needlessly low. A minima more than double the present figures could be obtained, but there were some circles of bright light on the ground and the makers did not like it.

Installations 30 and 34 are 2-way directive refractors. The magnification in installation 34 is approximately 8, and in installation 30 somewhat less than 8. One is conscious of glare in installation 34; it does not seem discomforting on the roadway, but it is slightly so at certain places on the footpath.

Installation 38 led to an interesting experience. The magnification in the refractors used is approximately 12, and with 500-watt lamps fitted the glare was distinctly harmful. Observers expressed their opinion of it as "insufferable," "very objectionable," "objectionable," "discomforting." Visibility was distinctly impaired by it, and on that point the observers were unanimous. The 500-watt lamps were taken out and 300-watt put in. The glare was very considerably reduced and there was marked improvement in visibility. On this point also the observers are unanimous, and it is interesting to note that it is possible with certain fittings to improve visibility by reducing the size of the lamps used with them.

Installation 39 is similar to installation 34. The magnification is approximately 6, and there is in consequence a reduction in the amount of glare. Installation 44 is in class D for minimum illumination but in the lower class, E, for mounting height. One would expect objectionable glare because of this but it is absent. Installation 46 is very uniform in illumination but is not depressingly so.

In viewing the installations one is struck by the fact that effective illumination is not always attractive illumination. For example, consider installations 9 and 21. Installation 9, with a minimum illumination of 0.006 foot-candles and a maximum illumination of 2.0 foot-candles (ratio 1 : 33), and installation 21, with a

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In studying the table on the opposite page, readers may find it useful to refer to the classification of streets given in the British Standard Specification, which is as follows :—

Class	Rated Mean Test-Point Illumination (Foot-candles)	Minimum Height of the Luminous Centre of the Light Source above the ground (Feet)
A	2.0 and upwards	30
B	1.0	25
C	0.5	21
D	0.2	18
E	0.1	15
F	0.05	13
G	0.02	13
H	0.01	Preferably 13

1	2	3	4	5	5A	6	7	8	9	10	11		12	13	14
Installation No.	Illuminant	DESCRIPTION OF FITTING	Consumption	Arrangement of lamps	Appendix II B.E.S.A. Specification	Width of carriageway	Average distance between lamps	Average dist. test point to two nearest lamps	Height of Light Source	Spacing-Height Ratio	Horizontal Illumination		Ratio Min. Max. Illumination	Class	Installation No.
											Min. in Foot-Candles	Max. in Foot-Candles			
					Fig.	Feet	Feet	Feet	Feet						
1	Elec.	Lantern with Dome Refractor	1,000w				91	51	28 & 25	—	0·700	2·000	1 : 3	C	1
2	„	Vitreous Enamelled, globeless type, lantern with trough reflectors ..	750w	Staggered	2	26	226	114	25	9·0	0·065	4·000	1 : 62	F	2
3	Gas	Square copper lantern; pre-heater with four nozzles in line; medium size mantles	10 c.f.	„	2	33	82	45	13½	6·0	0·060	2·000	1 : 33	F	3
4	„	Square copper lantern; earthenware reflector; 2-light burner; bijou mantles	3·5 c.f.	One-sided lighting	5	29	96	54	13½	7·1	0·012	0·500	1 : 42	H	4
5	„	„ „ „	3·5 c.f.	Staggered	2	29	91	48	13½	6·7	0·016	0·500	1 : 31	H	5
6	„	Square copper lantern; pre-heater with four nozzles in line; bijou mantles	7 c.f.	„	2	33	108	57	13½	8·0	0·020	1·000	1 : 50	G	6
7	„	Inverted type, with half-frosted and half-clear globe; four medium mantles in circle	10 c.f.	„	2	33	80	44	13½	5·9	0·066	1·200	1 : 18	F	7
8	„	Inverted type with clear glass bowl; four medium mantles in circle ..	10 c.f.	„	2	33	85	46	13½	6·3	0·050	1·700	1 : 34	F	8
9	„	Square copper lantern; four medium mantles in line	10 c.f.	„	2	33	85	46	13½	6·3	0·060	2·000	1 : 33	F	9
10	Elec.	Frismatic glassware bowl, 2-way ..	75w	„	2	18	95	48	13½	7·0	0·035	0·300	1 : 7	G	10
11	„	Mirror reflectors	75w	„	2	18	95	48	13½	7·0	0·033	0·400	1 : 11	G	11
12	„	Swan neck; enamelled reflector ..	60w	„	2	16	95	48	11½	8·2	0·014	0·270	1 : 19	H	12
13	„	Ripple glass globes	100w	„	2	16	95	48	13½	7·0	0·016	0·300	1 : 19	H	13
14	„	Vitreous enamelled reflector with glare screen	100w	„	2	18	84	43	15	5·0	0·014	0·800	1 : 57	H	14
15	„	Copper lantern; dome refractor ..	300w	Centre Lighting	4	72	105	64	28	3·7	0·100	0·500	1 : 5	E	15
16	„	„ „ „ ..	500w	„	4	72	105	64	28	3·7	0·105	0·800	1 : 8	E	16
17	„	„ „ „ ..	1,000w	„	4	72	103	63	28	3·7	0·500	1·550	1 : 3	C	17
18	„	„ „ „ ..	1,500w	„	4	72	96	60	28	3·4	1·000	2·500	1 : 2½	B	18
19	„	„ „ „ ..	1,000w	„	4	72	109	65	28	3·9	0·335	1·600	1 : 5	D	19
20	„	„ „ „ ..	500w	„	4	72	96	60	28	3·4	0·200	0·800	1 : 4	E	20
21	„	„ „ „ ..	300w	„	4	72	105	64	28	3·7	0·100	0·500	1 : 5	E	21
22	Gas	Square copper lantern; four bijou mantles in line	7 c.f.	Staggered	2	29	84	45	13½	6·2	0·050	1·000	1 : 20	F	22
23	„	Square copper lantern; 5-light bijou mantles in circle, fed from roof ..	8·75 c.f.	„	2	29	78	42	13½	5·1	0·034	1·200	1 : 35	G	23
24	„	Square copper lantern; directive glassware; four bijou mantles in line ..	7 c.f.	„	2	29	75	40	13½	5·5	0·065	1·000	1 : 15	F	24
25	„	Square copper lantern; 4-light bijou mantles in circle; burner fed from roof	7 c.f.	„	2	29	100	52	13½	7·4	0·020	1·000	1 : 50	G	25
26	„	Square copper lantern	7 c.f.	„	2	29	78	42	13½	5·8	0·035	1·000	1 : 29	G	26
27	„	„ „	10 c.f.	„	2	29	78	42	13½	5·8	0·055	2·000	1 : 36	F	27
28	„	Swan-neck fitting; 5-light Lijou mantles	8·75 c.f.	„	2	34	72	39	13½	5·3	0·050	1·500	1 : 30	F	28
29	Elec.	"Housing" lantern; enamelled reflector	500w	„	2	45	94	54	25	3·7	0·160	2·100	1 : 13	E	29
30	„	Two-way band refractor	500w	„	2	39	112	60	25	4·4	0·100	1·000	1 : 10	E	30
31	„	Floodlight type. (Impossible to give average distance between lamps, or spacing-height ratio, because they are not normally spaced).													31
32	„	Dome mirror reflector fitted with diffusing screen	500w	Staggered	2	37	120	64	25	4·8	0·080	1·200	1 : 15	F	32
33	„	Dome mirror reflector only	500w	„	2	37	93	52	25	3·7	0·100	1·200	1 : 12	E	33
34	„	Directive glassware, 2-way bowl ..	500w	„	2	39	114	61	25	4·5	0·225	1·600	1 : 7	D	34
35	„	„ band	500w	„	2	39	114	61	25	4·5					35
36	„	Enamelled reflector with glare screen ..	500w	„	2	40	109	59	25	4·3	0·140	2·500	1 : 18	E	36
37	„	Dome refractor	500w	„	2	40	117	63	25	4·6	0·105	1·700	1 : 16	E	37
38	„	Refractor bowl, 2-way	300w	„	2	40	106	57	25	4·2	0·225	0·450	1 : 2	D	38
39	„	Directive glassware, asymmetric ..	500w	„	2	40	112	62	25	4·5	0·300	0·750	1 : 2½	D	39
40	„	Prismatic glassware	1,000w	Centre Lighting	4	67	112	63	27½	4·0	0·350	1·700	1 : 5	D	40
41	„	"Housing" type lantern, large enamelled reflector	1,000w	„	4	46	114	60	27½	4·2	0·320	1·900	1 : 8	D	41
42	„	Enamelled trough reflector	500w	Staggered	2	33	121	63	22	5·5	0·130	2·600	1 : 2	E	42
43	„	Band refractor	1,000w	„	2	50	111	62	25	4·5					43
44	Gas	10-light medium mantles	25 c.f.	„	2	31	74	41	15	5·0	0·250	3·000	D Illn. 1 : 12	E Mounting	44
45	„	Similar to Installation No. 44													45
46	Elec.	Lantern with dome refractor	1,000w	„	2	36	125	66	25	5·0	0·500	2·000	1 : 4	C	46
47	„	Enamelled reflector, opal lamps ..	300w	Centre Lighting	4	72	96	60	28	3·4	0·080	0·800	1 : 10	F	47
48	„	Ripple glass globes	300w	„	4	72	130	74	28	4·6	0·043	0·300	1 : 7	G	48
49	„	2-way band	500w	Staggered	2	34	120	63	25	4·8	0·120	0·850	1 : 7	E	49
50	„	Mirror reflector	500w	„	2	33	114	60	25	4·6	0·275	0·825	1 : 3	D	50

minimum illumination of 0.1 foot-candles and a maximum illumination of 0.5 foot-candles (ratio 1 : 5). Installation 9 gives one the feeling of brightness and cheerfulness. Possibly the reflection from the tram lines helps, but the minimum illumination (0.06 foot-candles) is a fair index of the value of the installation from a visibility point of view, and possibly 2.0 foot-candles may be considered also a fair index of its attractiveness. On the other hand, installation 21 seems dull, flat, uninteresting, but the minimum illumination (0.1 foot-candles) is again a fair index of the usefulness of the installation from the point of view of visibility. Objects can be seen very readily on this road. The maximum illumination (0.5 foot-candles) would also be a fair index of its attractiveness, as against 2.0 foot-candles in installation 9. This feeling of drabness does not arise in other installations where there is the same or greater uniformity of lighting but where the minimum illumination is higher, e.g., installations 38 and 46.

Possibly lighting with a minimum below 0.1 foot-candles may be helped out in attractiveness by contrast of illumination. Lighting with a minimum above 0.1 foot-candles may not need that contrast. Installations equal in minima illumination are equal in effectiveness. If they differ in maxima illumination they differ in attractiveness and only very slightly in effectiveness. The one with the greater contrast is the more attractive so long as the ratio minimum to maximum illumination does not exceed about 40. Over that figure contrast seems to become unattractive. All this, of course, is assuming that the installations are free from objectionable and discomforting glare. Brightness of the road surface, brought about by the rays of light striking the roadway at oblique angles, does help the effectiveness of the illumination on the road surface, but it is difficult to do this without creating tiring, harmful, or at least discomforting glare, which in its turn impairs visibility.

The coefficient for glare (G) has not been given in the table as there is not a properly equipped photometric laboratory in the Lighting Department of Sheffield, and it is a slow, laborious and unsatisfactory job measuring the illumination on the street itself and arriving at the figures by calculation. However, the figure was obtained for some of the more glaring installations. In no case was the value of " G " found to be over 10. Paragraph 40 on page 18 of the specification is as follows:—

> " Such evidence as is available tends to show that when the coefficient " G " does not exceed 10, glare is not likely to be objectionable."

It would seem that the paragraph referred to requires reconsideration. An installation with a glare figure equal to 10 would be extremely glaring, and the visibility because of this glare would be much reduced.

Summing up, Mr. Colquhoun enquired: Does the demonstration prove the specification? He thought that it did. If the installations are arranged in the order of their minima illumination they do form themselves into what would be the order of preference from the point of view of effectiveness. But if arranged in their order of maxima illumination one finds, again from the point of view of effectiveness, obvious contradictions.

The glare clause might be made mandatory in order to prevent or handicap an installation with a high minimum illumination and considerable glare, and certainly something should be done to prevent an installation such as No. 4 coming within the specification. Mr. Colquhoun also suggested for consideration a change of distance between the lamps from " actual " distance to " effective " distance as already explained.

On the whole the specification has come through the test of this demonstration creditably, and it should be put into operation in every city and town in the country. If this is to be done properly lighting departments will require to be much better staffed and equipped in the future than they are now. This may be the subject of another paper in the future.

In conclusion, Mr. Colquhoun remarks: " I do assure the representatives of local authorities that the need for proper staffing and equipping of lighting departments is very real. Let me give you one instance. In fitting up this demonstration we found in a certain case that it was impossible, even by the most careful adjustment, to get the illumination on the road surface which we knew we should get from the distribution of light given by the particular refractor used. Eventually we found that the outer globes, by absorption, plus uncontrollable refraction of light by the outer globes themselves, and also possibly by internal reflections, were entirely cancelling the effect of the prismatic glassware. We took the outer globes off and the minimum illumination was raised from 0.275 foot-candles to 0.45 foot-candles."

Tests of Glare and Visibility

At this stage a few words may be said regarding the tests of the installations referred to above, which were conducted firstly by the special investigators under the supervision of Dr. Walsh and Mr. Stiles of the N.P.L., and subsequently by visitors under their direction.

The tests fell into two divisions: first, a general visual estimate of effects of glare; and, second, more detailed investigations by the aid of special experimental discs. Visitors were first asked to assess the visibility and glare of about ten installations according to their general impressions, grading them in a scale of numbers ranging from 0 to 5. They were also asked to ascertain, by stepping out, the distance d_1 between lamps at which the glare was apparently a maximum, and also to determine, again by stepping out, the distance d_2, between successive posts. (The second distance was asked for in order that d_1 and d_2 could be related, any personal peculiarity in pacing the distance thus cancelling out.)

These tests, and particularly the determination of d_1, were naturally somewhat difficult for an unexperienced observer; but it was hoped that in the mass the collected observations would enable some useful inferences to be drawn.

The second division of the tests involved the inspection of ten standard discs set up at selected points on the roadway. The discs were black in colour, with the points of the compass indicated round the edge by white lines. In front of these discs a second black disc, capable of rotation and bearing on its surface a white sector, could be inserted. In the series of discs used the degree of " whiteness " of this sector spot varied, being clearly evident in some cases, but only distinguishable with difficulty in others. Observers stood at a distance of 80 feet from the disc, and were asked to ascertain in turn the position of the white spot for each of the ten discs, which were exposed for 30 seconds.

Evidently this test was to some extent a test of conditions of visibility, but still more a test of the effects of glare. Most observers were only able to detect the position of the whiter spots; in cases where the contrast was small their detection required considerable acuteness of vision. But it was instructive to see how the surface of the disc was masked by the presence of " veiling glare " arising from exceptionally bright neighbouring sources, and it was repeatedly found that the white spot could only be identified when the eyes were shaded (a practice which observers were warned against, since shading the eyes would naturally defeat the object of the experiment).

Observers were furnished with cards on which to note down the results of their observations, and these were collected by the experts in charge of each group. On both occasions the tests were only concluded in the early hours of the morning, so that possibly visual fatigue may have affected the later readings. At the same time the entire series of readings should give a useful indication of those cases in which effects of glare were specially striking.

Some further notes on the Exhibition of Street Lighting in Sheffield will be found on pp. 232–240.

Non-Manual Control of Public Lighting

Papers on the above subject were read respectively by Mr. E. H. Horstmann and Mr. E. E. Sharp.

In introducing his subject Mr. Horstmann quoted a passage from the *Journal* of the Royal Society of Arts of 1867 to show that even at that early date a patent had been taken out by Dr. Thurgar for "a clockwork attachment to the taps of our street lamps," which was essentially similar in principle to modern appliances for the non-manual control of public lighting. Mr. Horstmann also exhibited a replica of this first automatic lighting appliance ever produced, made by his experimental department from the drawing accompanying the specification.

It was, however, not until 1898 that the introduction of auto-lighters for street lamps was seriously attempted by Mr. Cunning. Many such varieties have since been introduced. The early systems had many defects which have only gradually been eradicated. In order to gain a survey of the present position Mr. Horstmann circulated a questionnaire to those associated with 70 representative installations, comprising an aggregate of 207,490 lamps. The replies contain a mass of interesting information. The number of street lamps attended to by one man varies from 60 to 120 with hand lighting, the number of clock-controlled street lamps from 140 to 590. The saving in attendance is thus evident. Failures reported seem to be infrequent. The number of mechanical failures per night in clock installations was in no case more than 0.65 per cent., with a minimum of only 0.08 per cent. Important savings, in one case amounting to £1,500 on 1,283 lanterns, i.e., 23s. per lamp per annum, were reported. Equally striking was the saving in the cost of mantles, which ranged from 1.3 to 6.0 mantles per lamp per annum. Three installations with an aggregate of 5,239 lamps showed an average of 10d. per lamp per annum.

Mr. Horstmann emphasized the fact that in no case was an unfavourable opinion expressed, that in every case an economy was either reported or implied, and that, in general, a tribute was paid to the greater efficiency and improved public service resulting from automatic control.

In the next section of his paper Mr. Horstmann dealt with horological details, and subsequently gave instances of the considerable variety of types. Especially interesting was the description of the "solar chart" by the aid of which the time setting is determined. One detail of interest is the choice of "quick" or "gradual" lighting. Generally speaking the former is preferred, though much of the old trouble of "lighting back" with the slow lighters has been overcome by the introduction of the superheated burner.

Another schedule of enquiries, prepared for a well-known lighting engineer, contained a list of desirable features of a gas controller, the idea being to ascertain how different types compared in meeting these demands. There seems to have been only one type which satisfied every requirement, and there were some which complied with scarcely any!

Mr. E. E. Sharp's paper contained an interesting analysis of possible and practical methods of control. There are four electrical methods in use besides the rarely used method of switching direct from the power or substation. The author suggested, however, that there are only two *practical* methods, by clock and by pressure, with one other *possible* way.

Time switches form the only method of automatic control that shares with hand switching the possibility of universal application. Direct switching from the station usually involves laying an extra main, or at least an extra core in a cable, for no other purpose except to carry the street lighting, and it is doubtful if it can ever be justified from the standpoint of cost. The use of the selenium cell has been suggested, but the sensibility of the cell is so great that it would be necessary to fix very definitely the intensity of light and darkness at which the cell switch must operate, and to calibrate for this on each individual cell *in situ*. Further, as any passing dark cloud or the beam of a motor-car might cause the switch to operate, it would be necessary to fix a meter on each switching point. Somewhat similar considerations applied to the "Aga" system, based on the difference in expansion of two roads of metal, one polished with a dark matt surface, when exposed to light; though this system has been applied with advantage to coastal lighting.

Another possible system, the Olipel, operated by superimposing an alternating current of comparatively high frequency (usually about 100 for direct current but as high as 800 for alternating current) on to the existing lighting mains. There were five places utilizing this system, namely, Leatherhead, Winchester, Douglas, Tilbury and Maidenhead. It was a fascinating system technically, but the initial cost was high, and it had only limited possibilities.

There were other forms of relay systems which have advantages in special circumstances, but all involved one or more special wires and in every case such systems —like those mentioned above—were not truly automatic in that the relays have to be actuated by hand or by time switch at the actual moment that lighting or extinguishing was desired.

Following this introduction Mr. Sharp proceeded to discuss the technical and commercial aspects of time switches. The first point to consider was the design of clocks, which for street lighting were generally either 15 or 45 day or electrically wound. The author suggested that there was no great need for running a clock for more than 15 days, unless one went over to electric winding. The three enemies which clocks had to contend with were dust, rust and wear. The first and second called for a well-fitting outer case and good interior protection during the processes of winding and setting. Pivots needed special protection. Protection against rust was specially necessary in the case of the escapement, where no two metals should touch, i.e., the escapement should be very fully jewelled. A non-magnetic hairspring (which incidentally was rust-proof) was also absolutely necessary. Rustless steel had not yet proved completely satisfactory for clock parts. If pinions were carefully cut and pivots highly polished this gave adequate protection against rust, except in extreme cases. As a final precaution against rust Mr. Sharp emphasized the necessity of protection against ground damp. It was always well to seal off the bases of big posts where the switch was fixed in the ground or to seal off the cable entrance holes of the time switch box in the case of switches fixed to the top of the post.

An important item in relation to wear was oiling. It was generally agreed that oil tended to lose its effectiveness in the course of about 12 months, although oiling at intervals of two years was usually considered sufficient. Four years was certainly an outside figure. Recently claims had been put forward on behalf of an oil that would last 10 years; this would be an important advance if the claims were proved to be correct.

In dealing with contracts the author emphasized that these should not be badly effected by oxidation. Contracts should never be of the knife pattern and should come together firmly, free from bounce—otherwise there was danger of welding. The modern gasfilled lamp might take 12 to 15 times its normal current at the moment of switching on, so that the possibility of welding, or at least beading, was evident.

After dealing briefly with insulation and methods of mounting Mr. Sharp pointed out that electrically wound clocks were taking a position of increasing importance in street-lighting work. An electrically wound clock without a solar dial would, however, still require a man to go round once a fortnight to reset the times of lighting and extinguishing. On the other hand a hand-wound clock equipped with a solar device would still require attention for winding. The combination of the two features theoretically should do away with all need for attendance, though actually of course no clock in commercial working would keep exact time indefinitely. It seemed probable, however, that an accuracy of 30 minutes a year might now be expected and that it would be possible to leave electrically wound time

switches without attention for at least three months. One must, however, also bear in mind possible errors in the solar device which could not be made to follow the curve of sunrise and sunset exactly; at certain periods of the year it might be as much as 10 minutes out.

Before proceeding to a final summary of the commercial advantages of clock switches Mr. Sharp referred to another device—the Warren synchronous motor—which is not an electrical clock in the ordinary sense. He pointed out, however, that the accuracy of the device is dependent on the periodicity being maintained accurately, and that it would cease action in the event of an interruption of the station supply.

As an instance of the saving possible through automatic control the author mentioned experiences at Leyton, where, on an installation of 1850 time switches, the net annual saving is 14s. per post per annum. Experience in other localities suggests that the saving was never less than 12s. per annum, whilst in some areas it had been considerably greater than at Leyton. A really good time switch has a life of 20 years on street lighting and the maintenance cost is small—not more than 5 per cent. per annum. In conclusion the author put forward two propositions: (1) That hand switching is out of date, unsatisfactory and by far the most expensive, and (2) that of all other forms of switching time switches give the cheapest method that is practicable in every circumstance and without addition or alteration to existing station equipment.

Following the reading of these two papers an interesting discussion ensued. The discussion was interrupted in order to enable Mr. Stiles, of the National Physical Laboratory, to explain to those present the nature of the tests to be made on the street lighting specifications following the inspection in the evening. Amongst those who joined in the discussion were Mr. T. Harrison (London), Mr. Thos. Wilkie (Leicester), Mr. Lennox (Newcastle-on-Tyne), and Mr. H. Wardle (Liverpool). Mr. Wilkie reported that time switches were giving satisfaction in connection with the electric lighting at Leicester, but he was less certain regarding the advantages of automatic methods for gas lighting. Mr. Lennox agreed as to the general desirability of automatic control in street lighting, and Mr. Wardle mentioned that in Liverpool, where automatic control of gas lighting had been installed for many years, there had been a considerable saving in cost of labour. Mr. Colquhoun (Sheffield) stated that the had had only about three years' experience of automatic control, but during this period the results had been entirely favourable. In Sheffield there were nearly 2,000 electric lamps operated by time switches.

Mr. Horstmann and Mr. Sharp briefly replied to the discussion and Councillor F. Thraves then read his paper, an abstract of which will be found in the following column.

What the Public Want from a Street Lighting Department as Pedestrians, as Motorists, as Ratepayers

On Wednesday morning a very practical paper on the above subject was delivered by Councillor F. Thraves (Chairman of the Sheffield Watch Committee).

Councillor Thraves pointed out that street lighting is now a matter of first importance. The changed habits of the people and the enormous increase in road traffic—and its increasing speed—make bygone standards useless. Yet there is an enormous improvement since the days of the "Linkmen," and though no one is entirely satisfied with the present standard, street lighting now affords a considerable degree of comfort and safety.

The community may conveniently be divided into three classes: (*a*) pedestrians, (*b*) motorists, (*c*) ratepayers.

The pedestrian was the earliest user, and has presumably a prior right to the road. In towns and cities footpaths are provided, and if people could be persuaded to keep to them many accidents would be avoided, but still there are crossings to be negotiated, and in many cases this is a feat requiring alertness and agility. Good and sufficient street lighting is in these cases a vital necessity.

It is difficult, as a pedestrian, to express a preference for any one type of lighting as against others, and one method of arranging the lamps as against others, but it would appear that lamps placed alternately on both sides of the street is considered much the best.

In the suburbs and on the arterial roads, which have become the main lines for fast-moving traffic, footpaths have become an urgent necessity. If they are to be used, the surface must be as comfortable to walk on as the roadway itself. The present gritty surface of the footpath and the absence of light constitute a distinct menace to safety. One cannot be surprised if the pedestrians prefer the smooth roadway to the uncomfortable footpath, thus rendering public lighting all the more necessary.

Councillor Thraves also expressed the opinion that in the main thoroughfares of a town or city the lighting should be so good that powerful headlights of motor vehicles, with all their discomfort and danger, should be so unnecessary as to be prohibited. Poor lighting, with lamps very far apart, while not very satisfactory, is, however, a great deal better than no lighting at all. The blinding effect of motor headlamps is very much less where there is some measure of street lighting.

The requirements of the motorist are much more difficult to meet than those of the pedestrian. There does not seem to be a consensus of opinion on the various methods of street lighting amongst night motorists except on one point. All of them agree that a badly lighted street is much worse to drive in than an unlighted street, particularly on a wet night.

Street lighting with the lamps placed on one side only is dangerous. The standard lamp in use throughout the country is rather on the short side because it clashes with the shop-window lighting in many instances. Most of the motorists who travel much at night complain of certain towns and villages with upright mantles, many of them broken, and the lamps out of order, and in some cases even flat-flame burners in use. From the motorist's point of view they would be much better left out altogether.

An extended use of illuminated caution signs to indicate danger points and bends on the road would be very useful, and it is surprising, in the motorist's opinion, how few local authorities have dealt with the question with any degree of seriousness.

In the cities, where the main roads are comparatively well lighted and on which one can drive with safety and comfort, there is sometimes a danger in turning from the well-lighted main road into the unlighted—or poorly lighted—side road, and it is suggested that the first two or three lamps in the side street should be of a greater candle-power than the other lamps in that street.

Preference is expressed by some motorists, although not all, for the street lamps being over the centre of the roadway and very high up, because this shortens the shadows cast on the roadway by passing vehicles. Some delivery vans are very large, and if the street lamps are placed on the side of the roadway and at low heights very large shadows are cast which may be the cause of accidents. One motorist expressed the opinion that intermittent advertising signs should not be permitted, particularly in poorly lighted areas.

As Chairman of the Sheffield Watch Committee, Councillor Thraves next referred briefly to the requirements of the police from the street-lighting department.

The lighting of the older portions of a city with narrow, tortuous streets is even more important to the police than the lighting of the broad, straight thoroughfares. The former places should be so lighted as to leave no dark spots. Evil flourishes in the dark. The more light, the greater the tendency towards rectitude. Those who have little moral strength succumb to temptation more quickly where darkness prevails, those who are hardened in crime have their opportunity in the shadows. From this point of view alone efficient street lighting is desirable. Undoubtedly

good street lighting does help the police, both in the protection of life by securing public order and in the prevention of crime. It does not help to the same extent in the detection of crime and the apprehension of the offenders.

From the point of view of controlling road traffic quite another standard of lighting is required, but this has already been referred to under the section headed "The Motorist."

At the present time street lighting in Sheffield costs only ½d. per week per head of the population. Councillor Thraves said that as a ratepayer he felt that it was fair and just that he should be asked to pay for street lighting to the requirements of the pedestrian and the police, but he did not feel that it was right that he should be asked to bear the whole cost of meeting the requirements of the motorists. The infinitely higher standards of lighting brought about by the great increase in motor traffic should, he thought, be met by the motorists themselves, possibly through the Road Fund. The question was now a national one rather than a local one, and must be considered from a national point of view.

In conclusion, the author remarked that the absence in Sheffield of a central well-equipped Lighting Department was a severe handicap upon their Lighting Engineer. He felt the highest admiration for him in his tenacity in struggling against such adverse conditions. The Committee were fully alive to the need, and only financial stringency had prevented the erection of suitable buildings. They hoped that circumstances would soon change and so enable them to give Mr. Colquhoun and his staff the encouragement they so much deserved. Well-equipped workshops with whatever facilities are necessary for testing lamps and fittings and for research work, as also adequate office accommodation, were essential. It was the earnest wish of the Committee for Street Lighting to meet those requirements.

The Visibility of Objects in Artificially Lighted Streets

Mr. J. M. Waldram's paper on the above subject proved to be a very comprehensive one. He pointed out the complexity of the problems involved in street lighting. The paper dealt with only one aspect—the visibility of objects on an artificially lighted street—but this alone is sufficiently complex, involving, as it does, physiological and psychological factors.

It is by no means easy to frame a definition of what constitutes good street lighting. The parties interested in the visibility in streets are three, viz., the police, the pedestrian and the driver; and their requirements do not in all respects coincide. The police require that there shall be no dark corners or heavy shadows; the pedestrian requires to be able to see small obstructions, kerbs, puddles, etc., and the numbers on houses at all positions along the street. The requirements of the driver are far more exacting: he must be able to pick out with ease and certainty, and at a considerable distance ahead, any object on the road or any pedestrian without the use of his headlights; for it is considered that it should be unnecessary to use headlights on a properly illuminated road. The requirements of the first two parties are reasonably met by the provision of a certain minimum of illumination, measured not on the line joining the fittings, but at the point on the footpath most remote from the light sources, where the illumination would normally be expected to be a minimum, as laid down in the Standard Specification for Street Lighting. The problem of the driver is, however, one that requires further consideration.

"Visibility" depends on several factors. An object may itself be more or less conspicuous, i.e., it may exhibit more or less contrast with the background; this property may be described as the "conspicuity" of the object, and is independent of the observer's eye. "Perceptibility," however, is a distinct quality and does depend on the observer. It is defined by Bordoni as the reciprocal of the least perceptible brightness-contrast. "Noticeability" (an unlovely but convenient term) is some function of both the above factors, i.e., of the ability of an object to be seen and of a person to see it. "Perceptibility" has been studied in some detail. "Conspicuity" is less susceptible of definition. If one object has twice the contrast possessed by another we yet cannot say whether it will be twice as conspicuous. Conspicuity in a street varies with the reflection factor of the object and the position of the observer.

Objects are distinguished by the eye in three ways: (*a*) by contrast in brightness of object and its background, (*b*) by difference in colour between object and background, and (*c*) by a shadow cast by the object. Under the conditions usually present in artificially lighted streets (*b*) may be neglected, as colour can scarcely be distinguished. Contrast (*a*) may assume different forms. In the original paper this was illustrated by a sketch showing how the same object may be seen in contrast, either with bright or dark patches on the roadway or with specular reflection from the road surface; further, the shadow of the object may be contrasted with any of the above.

In the next section of the paper the author establishes a relation for the contrast presented by an object at mid-span, and discusses the variation in contrast as the object moves along the span. Whilst the value of the minimum contrast depends only on the value of the diversity of brightness of the road surface, the position of the object at which this minimum occurs is very indefinite. It depends on (1) the reflection factor of the object and the road surface, and (2) the distribution of brightness along the road surface. The position of minimum contrast is, however, usually close to the post on the side further from the observer, being further from the post as the object is lighter; with darker objects it may be impossible to ascertain the minimum possible contrast, for the object always appears as a dark object on a lighter background. In order to illustrate these points the author presented diagrams showing the conditions for a road having respectively a sand carpet and a wood paving. An instructive contrast between the distribution of illumination and brightness appears. The latter depends greatly on reflection from the roadway, and may actually be a maximum where the illumination is a minimum (not far from mid-span).

Hence it happens in practice that such objects as pedestrians are seen for the most part not by the light that falls on them, but by the light reflected from the road surface behind them. The curious fact is noted that when a pedestrian is thus seen by silhouette the first effect of a motor headlight when it begins to illuminate him is to destroy the contrast with the road and to render him less visible!

The reflection characteristics of road surfaces are very variable, depending on the nature of the surface, the amount of wear and the degree of dryness. A road surface, unless actually under water, never acts as a perfect mirror. Hence the image of the light source is drawn out into a line joining the observer to it, the width of this streak depending on the extent to which the surface departs from a polished one. In practice all manner of gradations are found and in the original paper the author presents some photographs comparing the distribution of brightness in the same street under varied conditions.

An interesting experiment described in the paper is the attempt to study these problems by the aid of small-scale models of streets. If a scale model is produced, with the same illumination as in an actual street, the visibility conditions are comparable; for the observer's eye is concerned only with the view seen, which consists in a mosaic of brightness substantially similar in the model and in the actual street. It is, however, necessary to prevent stereoscopic vision. In the original paper an illustration of the "model street" is given. The road-surface, composed of three-ply wood coated with zinc (which served as a common electrical return for all the lamps) was 18 feet in length and 3 feet in width. A mirror, placed at the end remote from the observer, had the effect of doubling the effective length of the

street. The " road surface " was made from black paper, coated with furniture polish to imitate specular reflection, or with a grey powder (a mixture of manganese dioxide and french chalk) to produce a diffusing effect. The lamp posts consisted of brass rods 14 inches high and furnished with small miners' lamps with a hairpin filament, operated on 2 volts. By frosting and blackening the lamp bulbs it was possible to alter the distribution. Small models carved in plaster to scale and painted in the correct colours (or, in some cases, flat models cut from paper) were used as pedestrians. The scale used was 1/30 to 1/60 full size.

The main use of the model was for qualitative demonstrations, but it may also prove of some value for quantitative experiments. It has, for instance, already been used in an attempt to determine the least contrast necessary under various conditions to enable the presence of an object to be noted, and also the least time necessary to observe an object. In the latter case the observer was afforded a short glimpse of the street and asked to state the number of objects present. The " glimpse " was gradually reduced in length until the observer began to make mistakes in the number of objects. This method proved not entirely satisfactory, however, and ultimately another method was adopted, based on the optical projection into the field of view of a photograph, on which the figures of pedestrians were inserted. One point brought out by these experiments was that there is a considerable difference in the experience of a motorist in practice—who does not know where a pedestrian may suddenly appear—and of an observer who knows where he has to look for the object. In the latter case, objects, which would ordinarily be dangerously inconspicuous may often be seen. The method is now being tried of determining the least contrast which a pedestrian must present if an observer is to notice him in any position in the field of view.

In the final section of the paper attention is drawn to several phenomena bearing on visibility. In the first place it would seem that the mechanism of visibility in high and low illumination is not quite the same. In the latter case the eye cannot perceive degrees in brightness in the object itself, which, at high illuminations give it form and substance. This effect has been termed in America " visibility by perspective," and it is by this means that objects are perceived in daylight, whereas in artificially lighted streets it is chiefly the outlines of things which are seen. Another somewhat unexpected experience has been that an increase in noticeability accompanies an increase of diversity of brightness; at least on roads where the surface is fairly mat. In one experiment on the model dispersive reflectors at a considerable height, giving practically a diversity of unity, were used. These lights were out of the field of view entirely, and there was therefore no glare. But the effect was something like moonlight, very dismal, and, except in a few positions, pedestrians could not be distinguished at all. On the other hand, in one other " freak " model installation, with alternate sharply defined transverse bands of darkness and bright illumination, the visibility was extremely good: it was, if fact, impossible to make the pedestrian (who appeared as an object half bright and half dark) vanish at any point in the street. Such a system of street lighting would be inadmissible in practice owing to the requirements of the pedestrian, but from the standpoint of visibility the effects are remarkable. An effect on wide roads is also mentioned. When diagonal or single spacing is adopted the diversity in brightness near the centre of the road may be much diminished and objects in this region become difficult to distinguish; for wide roads, double side spacing is therefore to be preferred.

Advantage may be gained by the use of fittings having a sharp cut-off so as to prevent all but the first source being seen. (This condition should be distinguished from that described above in which a particularly heavy cut-off, masking the light before the mid-span position, was adopted. The arrangement now described cuts off the light beyond the foot of the succeeding post and does not interfere with the mid-span illumination.) This arrangement has previously been suggested by Walsh*, who shows that an increase in perceptibility of from two to three times may be expected from the use of such a device. There can be little doubt of the superiority of such a system from the standpoint of avoidance of glare, but the fact of light being screened from the surfaces of buildings would be considered a drawback. This disadvantage might, however, be overcome by using a partial screen which allows light to fall on buildings but keeps it out of the eyes of observers on the roadway. Judged by convenience in seeing objects there can be no doubt about the superiority of such a system. Most people have experienced the sensation of comfort and good visibility when a prominent light source is obstructed, say, by the branch of a tree, and the corresponding sensation of discomfort if the observer changes his position and the light again becomes visible.

It has already been pointed out that when road surfaces are polished, instead of being diffusing, their appearance is completely changed. Under such conditions obstructions are detected by the aid of longitudinal streaks of light. For this reason it is usually better to provide sources on both sides of the road; there is then a greater probability of objects being perceived however the road curves. From this standpoint systems of central suspension are under a disadvantage, and the same applies to sources mounted on one side of the road only. Even if a very high illumination is provided, it is impracticable on a really wet road to increase its brightness materially at points outside the bright streaks. Moreover, as the shiny or wet surface approximates to a mirror the brightness of the streaks tends to become equal to that of the source; whereas on a diffusing road surface the brightness, even if the surface was perfectly white, could never be more than a small fraction of this value.

Two considerations arise from these facts: *Firstly*, that when the road is wet the position of the light sources is more important than their power or the distribution of their light; *secondly*, that a very small or a very distant source may suffice to give quite a useful streak on the road surface. With the model street already described the experiment of mounting small mirrors on the other side of the street on short posts, so as to reflect light up and down the roadway, was tried. It was found that this simple device was capable of giving luminous streaks which were quite useful.

In conclusion Mr. Waldram presented the following schedule of effects of various variables on visibility:—

Variable.	Effect on Visibility.
Illumination Level	Increase produces higher perceptibility, and if sufficiently increased allows discrimination by internal contrasts. Less important on wet roads.
Diversity of Illumination...	On dry roads increases diversity of brightness and contrasts. On wet roads unimportant.
Height of Source	Increase reduces brightness diversity and gives smaller background contrasts, but less glare and greater internal contrasts.
Spacing-Height Ratio	Increase produces greater glare, but higher brightness diversity and more marked contrasts. It should not be carried too far.
Arrangement of Sources—	Long spacing is bad on wet roads.
(*a*) Single Side	Not recommended; bad on polished or wet roads.
(*b*) Central	Better than (*a*), but liable to be bad on wet roads.
(*c*) Staggered	Good, but should be used with caution on wide roads.
(*d*) Double Side	Better than (*c*) for wide roads; good for wet roads.
Shading of Sources	Considerably reduces glare and increases comfort. Light should not be cut off buildings and kerbs.

The paper led to a useful discussion, of which some account is given on the following page.

* Public Works and Road and Transport Congress, 1927.

Discussion

In the discussion of the paper by Councillor F. Thraves, Councillor MELLING (Sheffield Watch Committee), as a motorist of many years' standing, emphasized the importance of good street lighting, and especially the elimination of glare. He felt very strongly that a substantial part of the cost of public lighting should be contributed by motorists through the agency of the Road Fund. Alderman GORDON (Liverpool) agreed that contrasts between very brightly lighted streets and less brilliantly illuminated side streets should be avoided. Bailie JAMES MACDOUGALL (Glasgow) also emphasized the importance of good public lighting in relation to traffic.

Mr. C. C. PATERSON, who opened the discussion on Mr. Waldram's paper, emphasized the importance of visibility, to which special attention was devoted in the Standard Specification. Mr. Waldram's paper had shown how much importance attached to the position of points, in addition to the provision of the requisite minimum illumination. There was, however, nothing in the paper to support the idea of "beacon lighting," i.e., points of light very far apart and affording only patches of light at long intervals. The essence of the paper was contained in the final table. It was most important to get these ideas clear, and to take a broad survey of the whole problem in studying the excellent series of demonstrations which Mr. Colquhoun had prepared.

Dr. J. W. T. WALSH said that one of the most important points brought out in the paper was the part played by contrast. Owing to the polished surfaces now general in street surfaces, less importance was now attached to uniformity of illumination. Excessive contrast either in the form of dazzle or flicker might, however, be objectionable. He recalled that this point was alluded to in Mr. Colquhoun's presidential address.

Mr. S. H. B. LANGLANDS (Glasgow) pointed out that theories of street lighting were undergoing revision as the result of practical experience. The paper had emphasized the importance of the nature of the road surface, and in future there should be close co-operation between lighting experts and city engineers. The paper had been illustrated by an excellent series of photographs; it was necessary, however, not to rely on photographs alone, for it was well known that the impressions recorded by the camera and the eye were not always identical.

Mr. HAYDN T. HARRISON also emphasized the importance of visibility, which depended not only on the character of the lighting but also on the reflecting power of objects in the street. It occasionally happened that at some point in a street an object approached a state of invisibility. The aim should be to eliminate this condition. One step which might help in this connection would be the choice of a light finish for the exteriors of vehicles, so that they tended to stand out in contrast with the darker surroundings.

Mr. W. J. JONES pointed out that relatively small variations in illumination (of the order of 10 per cent.) did not have a very marked influence on visibility; it was only when the changes were of the order of 50 to 100, or even 200, per cent. that the effect became very marked. Mr. Jones also alluded to Mr. Waldram's suggestion that lighting units should be placed on the outside of kerbs rather than the inside—a point of some importance in view of its relation to reflections in shiny surfaces.

Mr. E. J. STEWART (Glasgow) said that the paper illustrated a new stage in the theory of street lighting. The first stage had been the application of scientific methods of measurement of illumination; they had now to consider such data in relation to visibility. The effect of the surface of the roadway was of vital importance. It had been suggested that a driver should be able to pick out, without the aid of headlights, any object in a well-lighted street a considerable distance ahead. He (Mr. Stewart) would like to get some definite figures on this point. He observed that Mr. Waldram's paper had been concerned primarily with the lighting of the roadway. But the footpath should not be overlooked. Whilst the roadway was the area of chief importance to motor traffic, the pedestrian's needs should also be taken into consideration. Roads should be considered between the extremities of footpaths on either side, not only the section between the edges of pavements.

Mr. E. STROUD suggested that a reasonable minimum illumination still formed the best assurance of good lighting and visibility. Uniformity in illumination did not mean uniformity in brightness, and the provision of a certain minimum illumination ensured that there would be adequate light in other parts of the street.

Mr. J. M. WALDRAM, briefly replying to the discussion, explained that he had no intention of recommending "beacon lighting," though even this was better than no lighting at all. He agreed with Dr. Walsh that it was quite possible to have too much contrast, as well as too little. He was not sure that it would be expedient for vehicles to have light exteriors, as Mr. Harrison had suggested. He rather thought that this step might tend to reduce visibility and that the better course was to accentuate the brightness of the roadway. In regard to Mr. Stewart's query, he offered the suggestion that a motorist ought to be able to pick out a pedestrian or other object (without the aid of headlights) 300 feet ahead. This was approximately the length of two spans between lamp-posts. Central lighting was an efficient method of getting light on to the roadway, but it did not follow that this light would be reflected in the most desirable manner. He was not quite satisfied that the provision of a certain minimum illumination was alone a satisfactory criterion of good lighting. It should be remembered that in many circumstances the light reflected from a street surface was quite as important as the light impinging upon it.

Conference on Road Signs and Traffic

In accordance with the resolution passed at the meeting of the Association of Public Lighting Engineers in February last, a conference on the above subject was arranged by the British Engineering Standards Association on July 24th. Representatives of leading technical societies, Government Departments, and other bodies interested attended, and Lt.-Col. K. Edgcumbe presided.

After some discussion the conference was adjourned without any decision being taken regarding the formation of a committee. The problem of effecting standardization of traffic signs is obviously a somewhat complex one—no doubt international besides national aspects have to be considered—and it may ultimately prove an advantage to defer the immediate appointment of a committee. At the present time the A.A. is doing remarkably efficient work in this direction. It is chiefly in the case of special signs erected by local authorities that some degree of uniformity seems desirable.

Street Lighting Expenditure of American Cities

An interesting note by Mr. O. P. Ortler in *The Electrical World** compares the street-lighting expenditure of 42 American cities. The highest expenditure per capita per annum is that of Yonkers (N.Y.), which exceeds 2 dollars, but 14 other cities give returns exceeding 1 dollar per head of population per annum, and the lowest figure on the list is slightly under 0.5 dollar. The expenditure of most of the cities on public lighting shows an increase over that for the previous year. As regards the coming year, large increases are planned by three of the cities on the list, moderate increases by 23, and small increases by 13; only in one case is a small decrease anticipated.

This record is instructive as showing the tendency in the United States, where expenditure on public lighting is frequently on a bigger scale than in this country. It would be interesting to have similar data regarding British cities.

* July 7th, 1928, p. 25.

The Illuminating Engineering Society

Provincial Meetings arranged Oct.—Nov., 1928

An important departure is to be made by the Illuminating Engineering Society this autumn. Arrangements are being made for a series of meetings to be held at several leading provincial centres, with a view to creating local interest in the subject of illumination. As the centres selected are all of great industrial importance, it is proposed that at each meeting Mr. J. L. H. Cooper's paper (entitled " An Investigation of Electric Lighting in the Engineering Industry "), which aroused so much interest in London last session, will be read before a new audience. It is also proposed that at each gathering some leading London member should give a brief introductory address outlining the aims of the Society, and giving a general idea of the work it is doing.

The dates and localities of these four meetings are as follows:—

Birmingham—Monday, October 22nd, 1928.
Manchester—Monday, October 29th, 1928.
Newcastle—Wednesday, October 31st, 1928.
Glasgow—Thursday, November 1st, 1928.

Members of the Society resident in these areas are asked to make a special effort to attend, and it is also hoped that a contingent from London will be present at each meeting. These gatherings should have the effect of strengthening the representation of the Society in these cities, and may ultimately pave the way for the establishment of local branches.

Further particulars will be announced in due course.

The Photo-Electric Cell

In view of the interest now being taken in the application of the photo-electric cell to photometry, a recent contribution by Dr. L. R. Koller* deserves attention. The author describes the operation of the now familiar alkali metal cells, which have the important property that the current passing through them is directly proportional to the light flux falling on the cell. This fact is apparently connected with the quantum theory of light.

Unfortunately, however, photo-electric substances respond to the various regions of the spectrum in a manner widely different from the human eye. The maximum sensitiveness is in general located nearer towards the blue portion of the spectrum, and falls off rapidly towards the red. It is interesting to observe, however, that the point of maximum sensitiveness is not the same for all alkali metals, moving towards the red end of the spectrum as we traverse the periodic table. In the original paper this is illustrated by diagrams showing the distribution of sensitiveness throughout the spectrum for lithium, sodium, potassium, rubidium and cæsium. (This difference in behaviour has been put to practical use in an ingenious apparatus for determining the colour temperature of lamp filaments.) It is noteworthy that the maximum for cæsium is shifted so far as to be almost located in the yellow, which seems to suggest that this material might prove specially useful for cells employed in photometric work. For measuring ultra-violet light other substances, such as magnesium and cadmium, which are sensitive to ultra-violet but not to visible radiation, are used.

The departure from the characteristic curve of the human eye may be corrected by using an appropriate light filter, though, naturally, in so doing the sensitiveness of the cell is materially reduced.

The voltage applied to the anode of these cells is of some importance. In order to obtain the greatest sensitiveness the cell is used at a voltage slightly below the " glow voltage " (i.e., the limiting voltage at which a glow discharge occurs). Experiments on this point have recently been made by Campbell in this country.

The photo-electric cell at present finds application chiefly in the laboratory, and in a recent issue we gave a summary of a useful series of papers on this subject read before the American Illuminating Engineering Society.

* General Electric Review (U.S.A.), July, 1928.

Second International Exhibition of Light and Heat in Medicine, Surgery and Public Health

(To be held at the University of London, South Kensington, during October 29th to November 1st, 1928.)

Readers may recall that the first congress of this kind was held last year in Westminster, and proved very successful, though on that occasion the proceedings dealt almost exclusively with medical and therapeutic aspects of light. A feature was the attendance of medical men, both from this country and abroad.

At the conference and exhibition to be held in Kensington next October, however, a new departure is being made. On this occasion the afternoon of November 1st will be devoted to a series of short addresses dealing with various aspects of *illumination* in relation to health and safety.

The following subjects and authors are already announced:—

" Illumination and Public Welfare," by J. S. Dow (Editor of *The Illuminating Engineer*).

" Illumination and the Travelling Public," by A. Cunnington (*Lighting Engineer to the Southern Railway*).

" Illumination in Relation to Health and Efficiency in Industry," by H. C. Weston (*Investigator to the Illumination Research Committee and the Industrial Fatigue Research Board*).

Further particulars of the arrangements, which will include special exhibits of lamps and lighting appliances arranged to demonstrate the advantages of good lighting in the interests of health, safety and efficiency, will be announced in due course.

The exhibition and conference present an excellent opportunity of bringing the claims of good lighting before the medical profession, which is in a position to exercise a very beneficial influence in this field. The organizers of the exhibition are to be congratulated on this extension of its functions, which it is hoped will be a permanent feature of future conferences.

International Co-operation in Illumination

According to *l'Eclairage*, an inspiring address on the above subject was delivered by Monsieur Charles Fabry at a recent meeting called under the auspices of the newly formed National Illumination Committee in Belgium. Before a very representative audience, composed largely of leading men of science and representatives of public services, M. Fabry recalled the history of the International Commission on Illumination, which may be said to have had its origin in the International Photometric Commission, founded in 1900, largely on the initiative of the Société Technique du Gaz. Following the congresses held in Zurich in 1903, 1907 and 1911, the programme was extended and modified, and ultimately the present International Commission on Illumination, with national committees in 14 countries, came into being.

Three problems have mainly received attention from the Commission—the production, distribution and measurement of light. The last problem has had a profound influence, for it is only by the aid of accurate measurement that knowledge of sciences can advance. In other fields of science problems may be resolved by purely physical and mechanical means. But in the case of illumination things are otherwise; we have to deal ultimately with the peculiarities of the human eye, and thus physiology, psychology and hygiene are involved.

Despite this difficulty continuous progress has been made. Amongst problems which have recently received attention the author mentioned the design of beacons and projectors, the illumination of aerial routes and the design of motor-car headlights.

In conclusion, M. Fabry emphasized the importance of international co-operation in this wide field of knowledge, and looked forward to witnessing the young Belgian National Committee taking its place at the international congress to take place in the United States next September.

POPULAR & TRADE SECTION

COMPRISING

Installation Topics—Hygiene and Safety—Data for Contractors—Hints to Consumers

(The matter in this section does not form part of the official Transactions of the Illuminating Engineering Society; and is based on outside contributions.)

A Factory and Workshop Lighting Campaign

We have now received particulars of the forthcoming joint autumn campaign of the Electric Lamp Manufacturers' Association and the British Electrical Development Association, which is being launched during the period September to November, 1928. On this occasion the campaign is to be devoted to factory and workshop lighting, and aims at (1) banishing the use of bare lamps, (2) replacing obsolete equipment, (3) modernizing wiring installations, and (4) increasing illumination intensities.

The measures taken to impress these principles on manufacturers include a series of five successive postal communications, comprising letters and educational publications to 100,000 factories and workshops, and the circulation of information on the lighting of textile, printing, engineering and other specialized trades. Local service work will be conducted by the various E.D.A. committees, circles, and district officers, and the campaign will be aided by the publication of articles and the insertion of advertisements in the press.

We are glad to see that a special feature is being made of the elimination of bare lamps, and we hope that the campaign will result in a material improvement in factory lighting throughout the country.

The Lighting of Banks and Insurance Offices

The lighting of banks and insurance offices formed the subject of a recent issue of *Holophane Illumination*, which contains illustrations of many striking installations. In an introduction the advantages of good lighting from the commercial standpoint are emphasized. Good lighting is as essential in the office as the factory; in a bank or insurance office, where accuracy is of vital importance, any defect, such as bad lighting, which adds to the strain on workers may have serious consequences. Good illumination is a sound investment.

Apart from its practical advantages, good illumination plays a part in influencing the customer. The fine buildings and interiors of banks and leading commercial houses are designed to impress the public with a sense of confidence in their financial security and solidity. Good lighting plays an important part in revealing these interiors. The method of general lighting by handsome fittings, now becoming usual, enables this lighting to become an essential feature in the architectural design.

Whilst some concerns still favour local lighting of counters, there has during recent years been a marked trend towards the adoption of general lighting—one reason being that maintenance costs are thereby reduced. Apart from this, the fact of units being located high up, completely out of range of the line of sight, is a manifest advantage. In the olden days the development of local lighting probably arose from the recognition that the necessary high illumination could not readily be obtained by general lighting. But to-day this consideration no longer applies. Hence we find a general tendency towards well-designed systems of general lighting, such as that shown in Fig. 1, though examples of a combination of both systems, on the lines shown in Fig. 2, are also met with.

FIG. 1.—Midland Bank, Gracechurch Street, lighted by Holophane Reflector-Refractor fittings (night photograph).

FIG. 2.—Night photograph showing an effective combination of general and modern local lighting.

Some Notes on the Experimental Street Lighting Installations in Sheffield

THE chief impression left on one's mind after witnessing these experiments in street lighting in Sheffield was the magnitude of the effort. There were in all 50 distinct installations, occupying something like eight miles of streets. A few of the fittings were those of the Sheffield Corporation, but the majority were specially installed by leading firms in the lighting industry for the occasion. The useful participation of this representative series of firms in the display deserves recognition. Their co-operation involved a considerable amount of work—especially as, in some instances, their representatives did double service by also assisting in the organization of the tests conducted under the supervision of the N.P.L. A special tribute should also be paid to the services of Mr. J. F. Colquhoun and his staff of assistants, on whom fell the main burden of arranging the exhibition and the tests. This task was not a light one, for the lighting fittings had to be arranged in such a way as to comply with the British Standard Specification, and the taking of the series of photometric tests of practically the entire series of installations was certainly something of a feat.

The main object of the experiment was to demonstrate how the clauses for the standard specification could be complied with in practice. For this purpose the display answered admirably. It should, however, be explained, in justice to the firms exhibiting, that in some cases fittings were installed under conditions somewhat different from those which would probably be observed in practice; in other words, the idea of making an effective display was subservient to the intention of furnishing an instance of the working of the specification.

The only way of giving visitors a general impression of the display within a reasonable period of time was naturally by means of a motor tour, and the departure of the series of motor charabancs provided for this purpose by the Sheffield Corporation was an impressive sight. But naturally it was only possible to form rapid and general impressions under these circumstances. Those who took part in the visual tests had a somewhat better opportunity of studying certain installations at their leisure. The dominant impression received was the variety of ways in which the specification may be complied with. A remarkable diversity of types of fittings was seen in operation. The figures furnished by Mr. Colquhoun enable the consumption of gas or electricity for a given length of street to be determined. It would be a useful feature if, in addition, the initial cost of equipping a standard length of road with each of these systems could be approximately computed.

The conference was favoured by fine weather, and the surfaces of streets were therefore dry throughout. Nevertheless, one had opportunities of appreciating the important part played by reflection of light off the highly polished surfaces. One was also impressed by the influence on visibility exercised by glare—a drawback which it seems almost impossible to eliminate completely in street lighting. One recognized the adoption of minimum heights in the specification as a good feature. But, on the whole, experience confirmed the impression that the accentuation of candle-power at angles slightly below the horizontal in order to achieve approximately uniform illumination has drawbacks; some of the installations which were most successful in this respect were also those in which glare seemed most manifest. There was just one other type of installation one would like to have seen exploited—i.e., that involving a sharp "cut-off" in order to screen distant lights completely, on the lines suggested by Dr. Walsh at the Public Works and Transport Congress last year. Whilst no doubt open to objection from other standpoints, this method might have given instructive results in regard to the effect of glare on visibility.

Installations of "Wembley" Lanterns.—In what follows we propose to give a brief account of some of the chief installations. The display arranged by the General Electric Co. Ltd. was of special interest in view of the fact that this contained the only instance of a Class "B" installation (with a minimum of 1.0 foot-candle). Six different types of fittings were used. There were standard "Wembley" lanterns furnished with the symmetric one-piece prismatic glass refractor, and equipped respectively with 500, 1,000 and 1,500 watt lamps. A lantern of the housing type (without refractor) was also to be seen. But one of the most interesting

FIG. 1.—The New G.E.C. Asymmetric One-Piece Refractor for street lighting.

fittings was undoubtedly the standard "Wembley" lantern equipped with a new type of elliptical one-piece prismatic glass refractor. With this refractor the magnification factor at the peak angle attains 6.5, and this characteristic is favourable to the attainment of uniform illumination between posts. It is fashioned in a double prismatic formation on one thickness of glass, an arrangement which is conducive to minimum loss of light. Its main object is, of course, to direct on the roadway rays which would otherwise pass upwards and

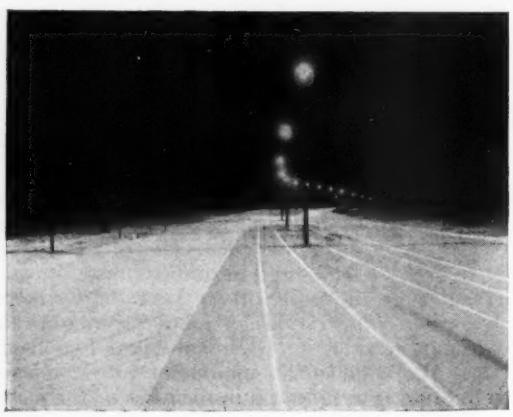

FIG. 2.—Showing G.E.C. Demonstration Street Lighting with 1,500-watt "Wembley" lanterns. Prince of Wales Road (an untouched night view).

be lost. Another special feature is the elliptical shape. The major axis is at right angles to the street, a condition which is very favourable to the use of refractors of the asymmetric type. These new refractors are interchangeable with the standard G.E.C. symmetrical one-piece prismatic refractors as fitted to the standard "Wembley" lanterns.

Installations utilizing the normal "Wembley" lanterns, and symmetric refractors occur in various parts of Sheffield. During the period of the conference a number of these units were also specially installed in the new Prince of Wales Road, which is planned in the form of a boulevard with a central double-rail tram track, and with a carriageway on either side for ordinary vehicular traffic. Fig. 2 shows the appearance of this street by night, the centrally mounted lighting units making an

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G.E.C. STREET LIGHTING

Untouched night view of Prince of Wales Road, Sheffield. G.E.C. demonstration street lighting at P.L.E. Conference. 1,500-watt G.E.C. "Wembley" Lanterns.

PUBLIC LIGHTING ENGINEERS' CONFERENCE: SHEFFIELD, 1928

The accompanying illustrations are from untouched night photographs of the G.E.C. street-lighting demonstrations arranged in connection with the above conference.

These installations were carried out with G.E.C. "Wembley" Lanterns and Osram Gas-filled Lamps.

The services of G.E.C. designers and illuminating engineers are offered FREE to all concerned with street-lighting problems. Experts will give information, make suggestions, or prepare complete lighting schemes without obligation.

Untouched night view of "The Wicker," Sheffield. G.E.C. demonstration street lighting at P.L.E. Conference. 1,000-watt G.E.C. "Wembley" Lanterns.

Untouched night view of "Fargate," Sheffield. G.E.C. demonstration street lighting at P.L.E. Conference. 1,000-watt G.E.C. "Wembley" Lanterns.

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imposing display. In one section of this street, where 1,500-watt lamps are used, the high minimum illumination of 1.0 foot-candle was attained. The effect of this bright illumination was accentuated by the somewhat light colour of the roadway, and the effect on entering this fine road avenue from a side road was quite striking. It illustrated, in fact, the desirability of "grading" the illumination in passing from main streets to side streets—a point that has often been emphasized.

In other sections of Prince of Wales Road, equipped with similar lanterns but with 1,000, 500 and 300 watt lamps, minimum illuminations of 0.5, 0.2 and 0.1 foot-candle were attained (corresponding with Classes "C," "D" and "E" in the specification). This road thus furnished a useful demonstration of the appearance of streets coming in the "B," "C," "D" and "E" categories. In Savile Street, where the new asymmetric refractor was in use, the minimum illumination was 0.3 and the maximum 0.75—a diversity coefficient of only 2½. In Fitzalan Square a minimum of 0.7 and a diversity coefficient of 3 were recorded. These are all installations furnishing a degree of illumination which would have been considered quite exceptional a few years ago.

FIG. 3.—Showing G.E.C. Demonstration Street Lighting with 1,000 watt "Wembley" lanterns in "The Wicker," Sheffield (an untouched photograph).

FIG. 4.—Showing the Lighting of Savile Street, Sheffield, with 500-watt "Wembley" lanterns asymmetric refractors (an untouched night photograph).

Holophane Exhibits.—Holophane prismatic street refractors of various types were incorporated in a large number of the trial installations arranged at Sheffield. A notable installation was that in Attercliffe Road, where two-way units equipped with 500-watt lamps were installed and a minimum illumination of 0.2 foot-candle was recorded.

"Directional lighting" has obviously a direct bearing on the problem of obtaining the minimum illumination values for the various classes of streets, as laid down by the British Specification.

The Holophane street refractors designed to provide this directional effect include a wide range of types and sizes, enabling the public lighting engineer to deal with the differences of spacing, heights, width of roadways, class of thoroughfares, road intersections, crossings, etc. Amongst these types may be mentioned: The two-way non-axial bowl type for installation at the sides of the roadway; the two-way axial bowl type for central suspension; the three-way bowl type for "T" intersections; the four-way bowl type for four-way intersections; and symmetrical bowl type for covering wide areas. All these types are supplied in sizes to suit lamps of different consumptions.

A further series is the Holophane band type, which gives a form of light distribution more suitable for close spacing on wider thoroughfares. This form of refraction is generally fitted inside lanterns with clear glass outer globes. A new band-type refractor has recently been designed giving a two-way directional distribution.

FIG. 5.—Holophane Bowl-type Refractor.

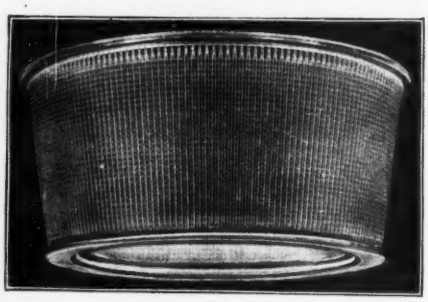


FIG. 6.—Holophane Band-type Refractor.

Yet another type is the Holophane "Dome," also for installation inside lanterns equipped with outer globes. The "Dome" refractor, however, is not made with diffusing prisms, the necessary diffusing of the light rays being effected by the outer globe, which is made in rippled or frosted glass. Dome-type refractors are also being made with an asymmetric light distribution, so as to redirect the maximum amount of light away from the house line on to the roadway proper. In all these Holophane street refractors the prism surfaces are protected from the collection of dirt and dust. They have smooth surfaces both inside and outside, and can therefore be very readily cleaned.

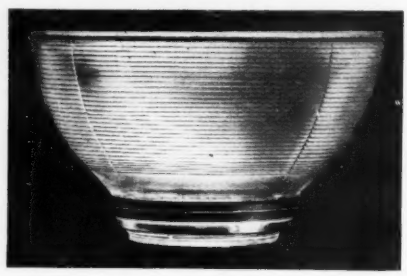
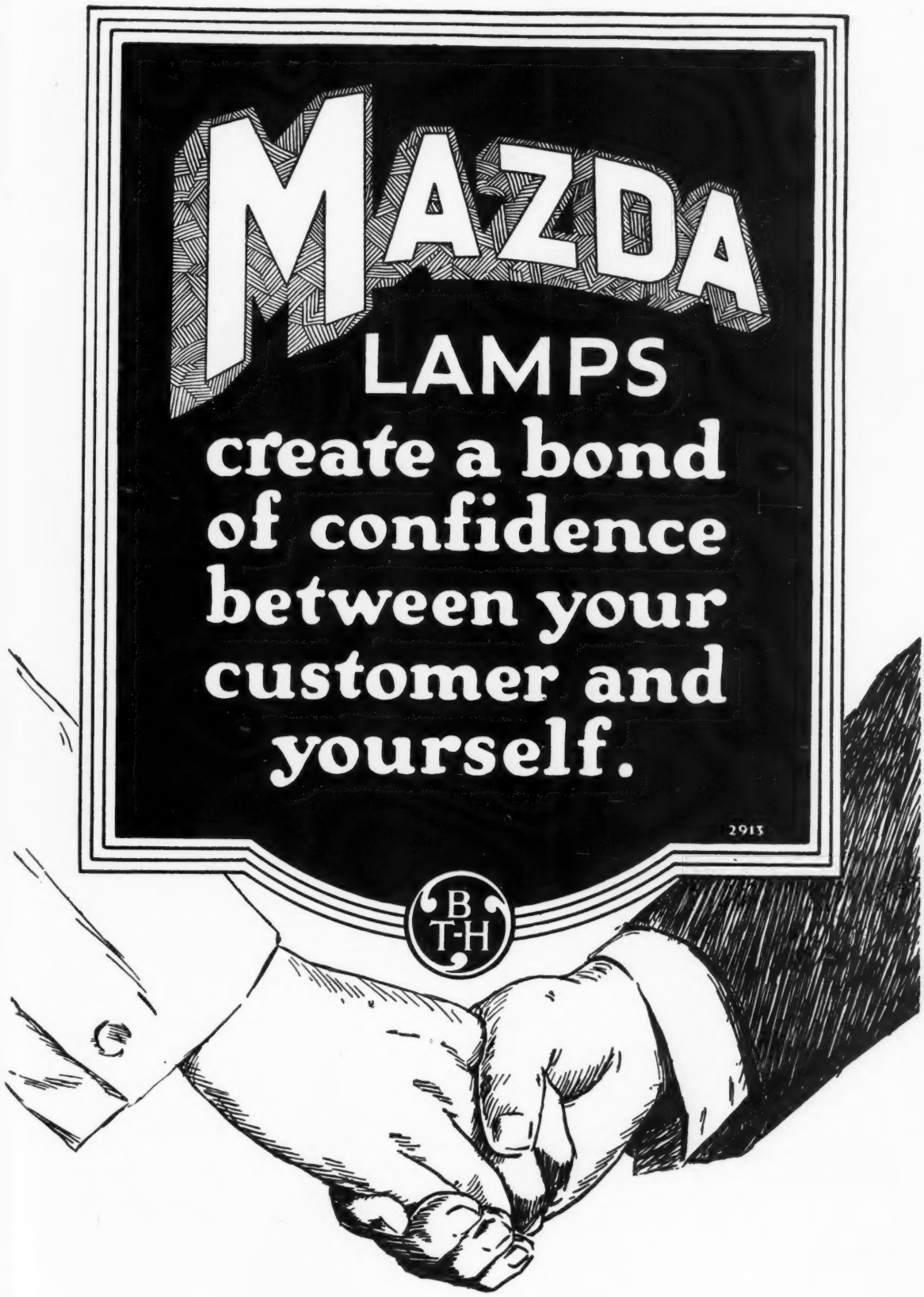


FIG. 7.—Holophane Dome-type Refractor.

A new and particularly interesting Holophane development in directional street lighting was the square-type



THE BRITISH THOMSON-HOUSTON CO. LTD. CROWN HOUSE, ALDWYCH, LONDON. W.C.2.

gas lantern with four-light gas burners. These lanterns were fitted with special prismatic refracting plates of heat-resisting glass for street gas lighting, to control the light rays from the superheated burner and give a lateral direction to the light distribution. The prismatic plates are designed for use with square-type lanterns having single or multiple burners. They are easily adapted to existing lanterns, and, when fitted, are readily detached and replaced for maintenance purposes. For ordinary street-lighting practice two prismatic plates are fitted in a lantern, each axial to the direction of the street.

The Holophane refractor plates are designed with a prismatic optical system which controls 180° of the light rays emitted in the mid-zone, refracting the upwardly emitted light in a lateral direction, and giving a two-way directional lighting system of two main beams of an intensity of four to six times the candle-power of the burner. The prismatic plates as fitted do not affect the normal light distribution from the burner for the zone 0°–70° from the nadir; the control being obtained from the rays emitted horizontally and upward. The increase of candle-power intensity secured at the wide angles from 70° to 85° is therefore obtained from the light not normally useful for street illumination. These plates, which form a one-piece asymmetric refractor, can be arranged in any formation to give a one, two, three, four or circular light distribution. This application of the directional system to gas lanterns is something entirely new, and constitutes one of the most radical innovations shown at Sheffield. The development of these units will be watched with considerable interest, as it seems possible that they may exercise a marked influence on the future of the public lighting with gas.

Benjamin Electric Lighting.—The units installed by the Benjamin Electric Ltd. included two types, the

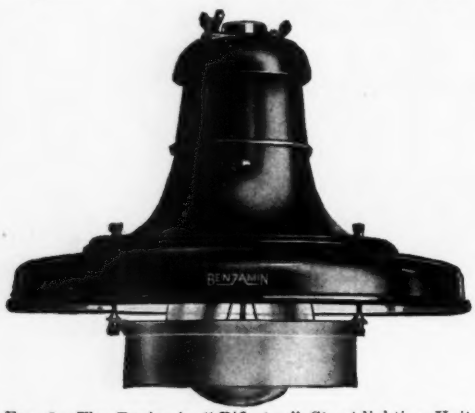


FIG. 8.—The Benjamin "Biflector" Street-lighting Unit.

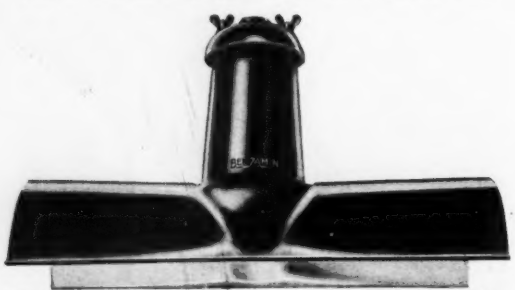


FIG. 9.—The Benjamin "Rodalux" Street-lighting Unit.

"Rodalux" and "Biflector." Both are familiar, and have been described previously in this journal. The feature of the "Rodalux" unit is the longitudinal effect obtained from the cylindrical form of reflector, which has been designed in several forms to meet the requirements of different methods of spacing. At Sheffield there were two such installations. Six of the ordinary form, equipped with 500-watt lamps, were used in Blonk Street (minimum illumination 0.13 foot-candle), while in Pond Street a special type equipped with 750-watt lamps was used. This form of lighting, which aims at spreading the light down the length of the street and obtaining approximately uniform illumination, works out economically in practice, and one judged that the effect is obtained with a smaller degree of glare than often occurs in such cases. The other Benjamin unit, the "Biflector," is also well known to readers. This achieves an exceptionally "extensive" curve of light distribution with a minimum of glare owing to the use of a diffusing metal rim under the reflector. These units were installed in Attercliffe Road (minimum illumination 0.14 foot-candle) and elsewhere proved quite effective, the screening effect against glare being particularly noticeable. One other form of unit, a Benjamin enamelled reflector with opal lamp, installed

FIG. 10.—Square-type Gas Lantern fitted with Holophane Prismatic Directional Refracting Plates.

by Messrs. Siemens Electric Lamps and Supplies Ltd., may also be noted. We understand that some photographs of these interesting installations are being taken, and we hope to be able to present some of these in a later issue.

"*Mirrorlite*" *Units.*—The idea of using a diffusing glass rim was again illustrated in the "Mirrorlite" units installed by Messrs. Korting & Mathiesen Ltd. There were six ordinary "Mirrorlite" lanterns in Attercliffe Road, three being of the ordinary type and

FIG. 11.—General appearance of K & M "Mirrorlite" Lantern (Pattern No. 589, 300 to 1,000 watts).

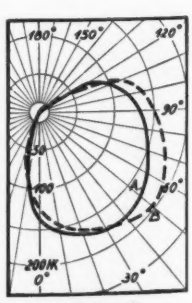
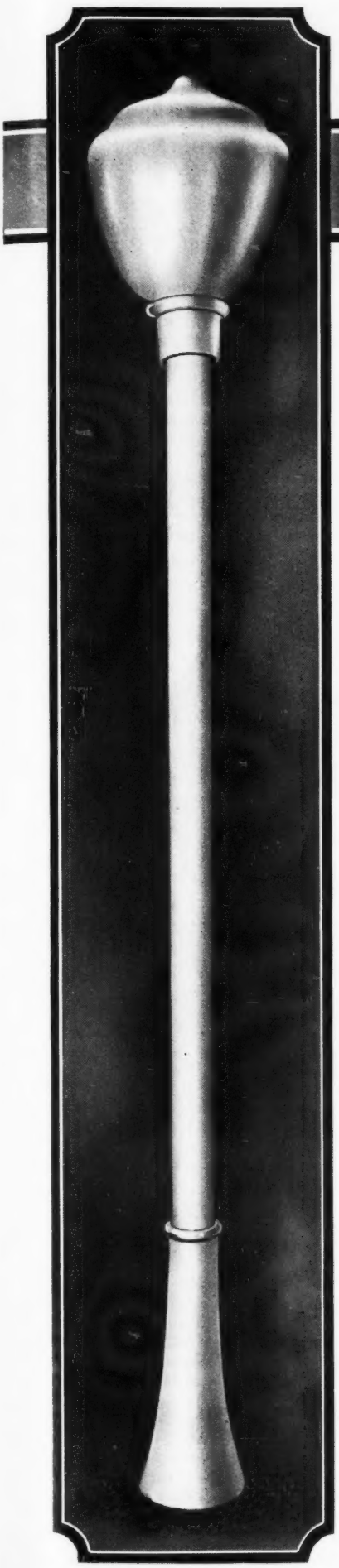
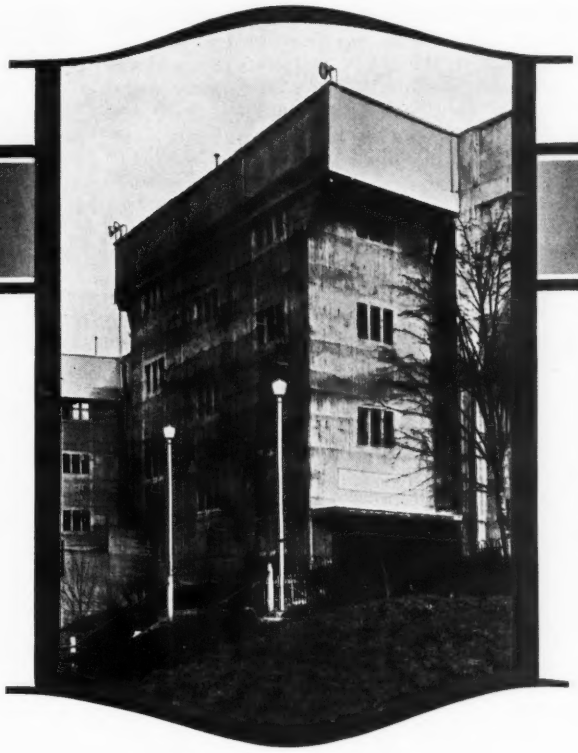


FIG. 12.—Polar Curves:—
A—With Ring Filament Lamp.
B—With Zigzag Filament Lamp.

three with the new diffusing band—the latter installed in the section of the road lined by houses in order to





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illustrate the effect of this band in diffusing light upwards. These units were equipped with 500-watt lamps, but adjacent to the above installation there was also one " Mirrorlite " lantern in a small square fitted with a 1,000-watt lamp and also equipped with the diffusing band.

The comparison of these two types of unit was most instructive. Readers will recall that we have recently described the chief features of the " Mirrorlite " lantern, which is shown in Figs. 11–12. Of late years there has been a distinct tendency to adopt concentrating opaque reflectors for street lighting. This method inevitably leads to a somewhat high diversity factor, though the special inner prismatic reflector adopted in the ordinary " Mirrorlite " unit is designed to give an improvement in this respect. But any lack in uniformity of illumination is considered to be more than counterbalanced by the fact that the lighting units filament of the lamp is completely screened. Certainly the installation of these units was comparatively free from glare, though naturally the bright surface of the inner reflector was visible at some angles. The adoption of the diffusing band struck one as a distinct improvement from this standpoint. Apart from its primary advantage of diffusing a certain amount of light upwards and preventing a hard shadow line on adjacent buildings, the diffusing ring helps further to eliminate glare and gives a softer and more pleasing effect. It is worth noting that the minimum illumination on the roadway was almost the same—0.1 foot-candle with the simple reflector, and 0.08 when the diffusing band was employed—so that the latter evidently did not materially diminish the intensity in the street notwithstanding the higher illumination on surrounding objects.

Bi-Multi Street-Lighting Reflectors.—The Electric Street Lighting Apparatus Co. installed in a section of Attercliffe Road a series of their bi-multi mirror reflectors, of which examples are shown in Fig. 13. This fitting has also been previously described in *The Illuminating Engineer*. It utilizes an ingenious combination of mirrors to give an exceptionally high " multiplication factor "; it is stated that along the length of the street the candle-power is approximately seven times as great as that given by the lamp alone. In this installation the " Unit " system bracket has been used to bring the height of the short columns up to that specified in the Standard Specification, thus illustrating how public lighting engineers can deal with the problem of adjusting the heights of existing posts when bringing installations into line with the Specification's requirements.

FIG. 13.—Showing a pair of the " Bi-Multi-Reflectors " mounted on post.

This lighting unit lends itself readily to the conversion of existing lanterns. For this purpose a slightly modified type is made; this is fitted with four spring supports which are slipped into place in the lantern. The section of Attercliffe Road equipped with these units came within Class " D " of the Specification; 500-watt lamps were used. The minimum illumination was 0.275 foot-candle and the diversity coefficient approximately 3.0.

Met-Vick and Other Lanterns. — Six Met-Vick " Caledon " lanterns were installed in Savile Street. These utilized two-way non-axial Holophane refractors equipped with 300-watt lamps, each reflector giving two beams at 120°. Lanterns are also equipped with the Wardle patent vibration-proof lampholder. The carriageway at this point is 40 feet wide, and the average distance between the lamps is 106 feet. The lanterns are mounted at a height of 25 feet on brackets projecting 6 feet over the carriageway. The minimum illumination

FIG. 14.—The " Caledon " Lantern.

was 0.25 foot-candle, the maximum 0.45. The diversity coefficient (ratio of maximum to minimum illumination) was thus only 2—a remarkably low value. The installation comes within Class " D " of the Specification, and aroused much discussion, one of the chief questions being whether this degree of uniformity was desirable or whether the effect was liable to be monotonous. On this point some difference of opinion seemed to exist. In the course of the tests the interesting discovery was made that better results, as regards visibility, were obtained when 300-watt lamps were substituted for the 500-watt ones. It is believed that this was largely due to the nature of the lanterns, which gave results comparable with those obtained with many lanterns of the 500-watt type—an important consideration in view of the difference in cost of current for operation.

The " Glasgow " fitting, installed by the Engineering & Lighting Equipment Co. Ltd., is one of those using a band type of refractor, designed to concentrate the light in two main directions, and is intended mainly for use in cases where units are spaced relatively near together and where high illuminations are required in the immediate vicinity of the units. This is usually the case in main streets, where the directional characteristics afforded by the two-way Holophane band refractor are distinctly advantageous. This new refractor is estimated to multiply the candle-power of the lamp five times, the two main beams being located at an angle of 150°. The focal position of the lamp can be adjusted externally, and the holder is carried on the familiar anti-vibration disc adopted by this firm. These lanterns were installed with 500-watt lamps in Attercliffe

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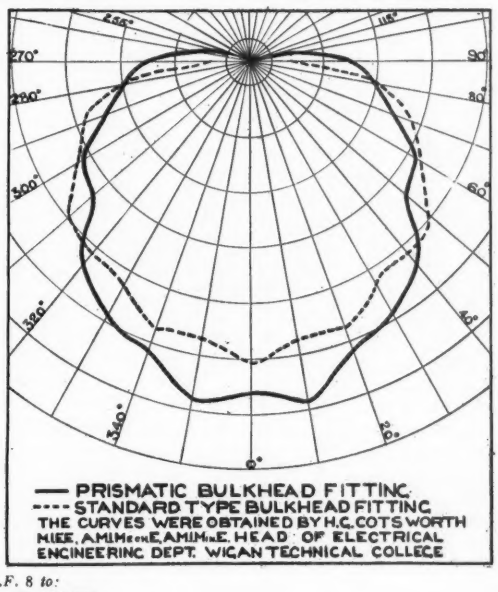

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Road, where a minimum illumination of 0.1 foot-candle (Class " E ") was obtained.

The " Bruce " lanterns, installed by the Wardle Engineering Co. Ltd. in Prince of Wales Road, are equipped with a Holophane dome reflector refractor (see Fig. 7) and furnished with the Wardle vibration-proof holder. Lamp adjustment is effected by means of a rotation of the externally situated focussing head. These lanterns were equipped with 1,000-watt lamps, and furnished an illumination of 0.3 foot-candle minimum (Class " D ").

" *Blaizolite* " *Street-Lighting Units.*—We now come to one of the most original lighting units shown—the " Blaizolite " lantern exhibited by Messrs. Lewenz & Wilkinson Ltd. This lantern, which is illustrated in Fig. 15, has a cylindrical body which encloses a system of seven plano-convex lenses and six mirrors surrounding the lamp-bulb. Six of the lenses are mounted round the lamp, and opposite to each of these is placed a mirror which can be so adjusted that the light can be reflected at any desired angle. The seventh lens is mounted in front of the bulb and between it and the diffusing glass front. The six mirrors are hinged

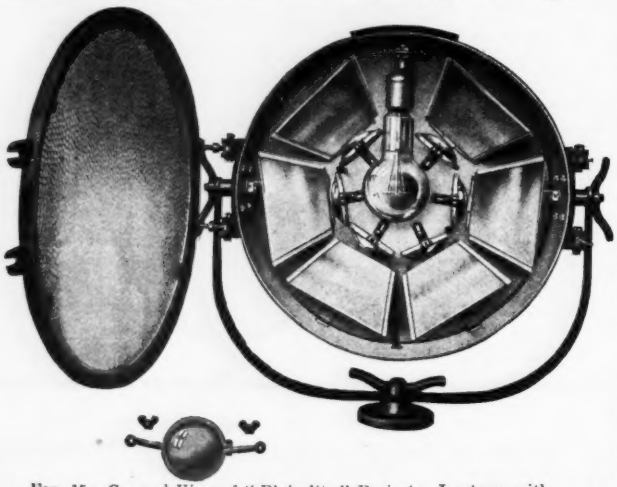

FIG. 15.—General View of " Blaizolite " Projector Lantern, with diffusing cover open.

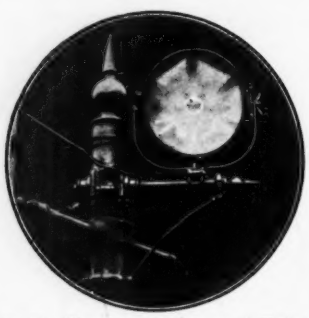

FIG. 16.—Showing attachment of Unit to Street Standard.

at their inner edge, the outer edge being fastened to a quadrant passing through the back plate, where it is secured at the desired position by wing-nuts. Each mirror may also be rotated through slots in the back plate in the plane of the latter. The lantern is enclosed by hinged doors at back and front, the hinges being so arranged that any door may be reversed. The door frame carries a sheet of hammered cathedral glass, which effects the requisite diffusion.

These lanterns, we understand, have been extensively used for the illumination of large exterior areas such as railway sidings, colliery works, quarries, harbours, etc. Their application to street lighting was in the nature of an experiment. The lanterns were mounted in diagonally opposing pairs with their backs to the oncoming traffic, the idea being to flood the street with light. Distances between opposing pairs will usually vary from about 120 yards for main streets in a city to 200 yards on arterial roads, etc. The slanting rays have been found very advantageous in showing up unevenness of the roadway. The lantern recommended for street lighting is equipped with a 500-watt lamp. Figs. 15 and 16 give an idea of the appearance of the unit.

The application of these units to street lighting was a novel step. The illumination appeared to be good, but the " clock-like " appearance of the unit is somewhat unusual in street lighting. To anyone facing the unit the brightness was rather high—though not more so than some other installations in which glare at angles slightly below the horizontal seems to be an almost inevitable result of efforts to obtain a low diversity factor. Naturally, the conditions applying in this case were somewhat different from those under which such units would ordinarily be used, the height of suspension, for instance, being less than that ordinarily adopted for floodlighting large areas. This particular installation hardly fell within the ordinary requirements of the Specification. But such units may nevertheless have useful applications for lighting squares and in other cases in which something in the nature of floodlighting is desirable, whilst for the lighting of arterial roads, where from motives of economy the distance apart of units is necessarily large, they may also have interesting possibilities.

B.T.H. Street-lighting Equipment.—The accompanying illustrations show day and night views of the two B.T.H. " Leeds " lantern installations. Figs. 17 and 18 illustrate 300-watt size lanterns attached to the tramway standards on the Prince of Wales Road. The mounting height is 25 feet, the average spacing 120 feet, the spacing-height ratio thus being 4.8. A maximum illumination of .3 foot-candle and a minimum illumination of .043 foot-candle were obtained, giving a diversity ratio of 7 to 1.

Figs. 19 and 20 show smaller lanterns of a similar type employing 100-watt lamps on the Fretson Road. In this case the mounting height is 13½ feet, the average spacing being 95 feet, and the spacing-height ratio 7.0. The Fretson Road is in a residential district, and the lanterns are in staggered formation. The pleasing appearance of this lantern makes it particularly suitable for residential districts.

This street-lighting lantern consists of a canopy made of copper spinning reinforced with wrought-iron spider, and a globe cage in basket form consisting of wrought-iron strips attached to a cast ring. The globe is of B.T.H. " Nelite " glass. An all-porcelain lampholder and inner reflector in white vitreous enamel are employed.

The B.T.H. " Nelite " glass globe is of the rippled variety with a trace of opal, giving excellent diffusion, but not materially interfering with the directional control. When lighted at night, the rippling gives the effect of innumerable minute crystals which give life and sparkle to the lantern, which is not found with plain opal globes. At the same time there is an absence of glare. The rippling also has the advantage of making the globe practically self-cleaning, since rain falling on it is drained off naturally by the small channels, and carries away a good proportion of any dirt that may have collected.

The general lines of the lantern, combined with the exceptionally beautiful glass, give it a pleasing appearance by day as well as by night. The " Leeds " lantern, which was designed by the B.T.H. Co. some time in advance of the conference, was on view, both diffusing lanterns and " directional " devices being well represented. It appears to be specially successful in eliminating the difficulty of glare, which, by general consent, has a prejudicial effect on visibility. One could not but be struck by the important rôle played by the various optical arrangements modifying the natural distribution of light from the source, on which the possibility of obtaining moderate " diversity ratios " mainly depends. The chief problem now before lighting experts is to secure the ideal distribution of light without the glare becoming excessive.

FIG. 17.—Daylight View of B.T.H. "Leeds" Lanterns attached to Tramway Standards on the Prince of Wales Road, Sheffield.

FIG. 18.—Night View of B.T.H. "Leeds" Lanterns attached to Tramway Standards on the Prince of Wales Road, Sheffield.

FIG. 19.—Daylight View of B.T.H. "Leeds" Lanterns attached to Standards on the Fretson Road, Sheffield.

FIG. 20.—Night View of B.T.H. "Leeds" Lanterns attached to Standards on the Fretson Road, Sheffield.

Gas Lighting.—Apart from the exhibit of Holophane Ltd., mentioned on p. 234, there were a number of examples of low-pressure gas lighting, much of it executed on very sound lines.

In Church Street, Messrs. Wm. Sugg & Co. Ltd. had fitted 13 10-light "Rochester" suspension lamps fitted on wrought-iron swan-neck supports. These lamps were equipped with Horstmann automatic controllers. Special globes, frosted over the lower half, were provided. This installation excited much favourable comment, attention being drawn to the good conditions of visibility secured, notwithstanding the relatively low height of the posts. Upright "Littleton" lamps, also equipped with Horstmann controllers, were fitted in the City Road, 10 of the lamps being fitted with clear globes and 10 with half-frosted globes similar to those used in Church Street.

The lamps in Church Street consumed 25 cubic feet per hour, and the minimum illumination recorded was 0.25 foot-candle, thus meeting the requirements of Class "D" in the specification. In City Road the consumption was 10 cubic feet per hour per lamp, and the illumination was of the order of 0.05 to 0.06 foot-candle, thus falling within Class "F."

Messrs. Foster & Pullen, in their installations confined themselves to providing the prescribed grade of illumination in the simplest and most efficient manner, a minimum of 0.05 foot-candle (Class "F") being recorded. This result was obtained by the use of 4-light superheater burners in square lanterns, the burners, with No. 1 (Bijou) nozzles, being arranged to secure the maximum illumination along the road. A feature of the "Avil" lanterns furnished by this firm is the robust and simple construction, the gas and air

regulators being absolutely positive in action, and all springs, sleeves or other parts liable to get out of order are eliminated. Messrs. Foster & Pullen Ltd. have also made a feature of special signal lanterns for the control of street traffic—a branch of public lighting which was not discussed on this occasion, but is becoming of considerable importance.

Amongst other gas exhibits we may note the new type of street lamp cluster loaned by the Bland Light Syndicate Ltd. This is made of magnesia, with a specially shaped magnesia disc, placed exactly 1¼ in. from the ignition point of each mantle nozzle. It is claimed that it is absolutely impossible to make this burner light back, and it gives a duty of 150 candles measured at the horizontal and 190 at 10° to 15° below the horizontal.

Lighting Trades Ltd. participated in the demonstrations of street lighting by fitting up a number of lamps in Staniforth Road (Class " F "). There were six square copper lanterns and six " Silva " lamps, all fitted with a 5-light Bijou burner. The chief feature of this exhibit was the incorporation of the " Renown " burner, an interesting novelty which was shown at the conference of the association in Brighton last year. Readers will find a description of the device in our issue of October, 1927 (page 299). The curious design of the interior of this burner is claimed to render lighting back impossible, and this result is attained with complete elimination of corrosion and the absence of wire gauzes or specially constructed nozzles. We understand that the introduction of this device has led to considerably reduced labour charges for maintenance, as well as promoting higher efficiency. Quiet lighting and extinguishing is secured even when the normal consumption is reduced by 25 per cent. and transitory fluctuations in pressure have little influence.

In conclusion, it may be mentioned that this description would be incomplete without a reference to the use of the Newbridge automatic lighting controllers furnished by the Horstmann Gear Co. Ltd., which have played such an important rôle in facilitating the distant control of gas lighting. Many varieties of this device are available, but special attention may be drawn to one of the latest types, which is capable of passing 20 cubic feet per hour and has an overall depth of only 5½ inches. We understand that the Company is also introducing a new type of electrically-wound clock for use with electric time switches, which is of very robust and compact design. When used for street lighting this device will be furnished with the Newbridge solar compensating dial, a highly ingenious piece of apparatus which enables any lighting schedule to be followed exactly from day to day.

This brings to an end our description of the unique series of street-lighting fittings installed at Sheffield. The study of these various methods of complying with the standard specification was of great interest, and the advantage of seeing the lamps actually installed in the street, instead of merely being exhibited in a room, was very considerable. This is probably the first time that an experimental street-lighting installation on such a scale has been attempted—certainly the first time in this country, and it should serve as an instructive object lesson to lighting authorities throughout the country.

Floodlighting and a "24-hour Day"

We have received from Messrs. Lewenz & Wilkinson Ltd. a letter commenting on a recent note in our journal quoting a recent contribution on the subject of floodlighting by Mr. A. H. Smith in *The Electrical World*. It was remarked that in many cases of urgent work, for example in docks, quarries, railway yards, etc., floodlighting had enabled work to continue at night and made possible a " 24-hour day." We understand that the " Blaizolite " floodlighting units introduced by Messrs. Lewenz & Wilkinson, and described elsewhere in this number, have recently been applied in a number of cases of this nature with good effect, and we hope shortly to be able to publish some photographs illustrating their use in railway yards and for other forms of night work.

Factory Lighting in the Summer Time

There are always problems confronting the factory manager, some of which are more pressing than others. It is only natural that the less urgent ones should be shelved to a more convenient season—which usually means when the need is immediate. The problem of factory lighting is, in general, less pressing during the summer months than during the winter. Hence the manager is liable to forget it for a season and concentrate upon something of more immediate importance.

Nevertheless, it is not altogether wise to suspend operations entirely, especially in connection with a service where inactivity means deterioration. Even during the slack season the services should be maintained in an efficient state, so that they can respond to any sudden call.

Moreover, with our experience of English summers, we should recognize that the sudden call may come at any time. A sunny morning gives place to a rainy and cloudy afternoon, and it is not long before the factory requires lights. If the efficiency of the lighting services has been maintained the matter is adjusted in a few moments without interruption to production; but if not, there is delay until such time as the services can respond.

The cost of such a delay may prove considerable, for the whole factory may have to cease production for an hour, or " go slow " for an even longer period, while the lighting services are being put in order. Last summer, one factory, which was illuminated by high-pressure gas lamps, made a sudden call for lights, and it was found that the pipes were full of water and most of the mantles were broken, there being none in store to replace. Some considerable time elapsed before any sort of service could operate, and in the meantime 200 men, youths and girls were idle. In another factory (lighted by electricity) the sudden call brought about the discovery that most of the lamps were useless, and that there were no supplies in the store. It transpired that the storekeeper, although maintaining definite stocks of lamps during the winter season, did not think that lamps would be needed during the summer, and allowed his stocks to run out. Thereafter it was arranged that the store should hold " winter stocks " and " summer stocks " of lamps, the latter being sufficient to meet any emergency, so the same trouble is not likely to recur.

But apart from such cases there is another reason why the lighting services should not be neglected during the summer months. It may be that during the preceding winter ideas for making the services more efficient were mooted, but could not be carried into effect because the services were continually in action. Surely in these circumstances the summer season is the best time for carrying out improvements in readiness for the following winter. One engineering firm deals with this matter systematically. In August of each year the works are closed for ten days for stocktaking, and during this period the lighting services are subjected to a thorough overhaul, and any changes suggested by a study of the services in operation during the preceding winter are carried out. In this way efficiency is assured with a minimum of disturbance.

Sometimes, although it is known that the services could be improved, the lighting engineer is so occupied with day-to-day affairs during the winter months that he has no time to make a thorough investigation and draft out a comprehensive improvement scheme, but this does not apply to the summer season. During the summer season the engineer in charge will usually find that he has the leisure to consider the problem in all its bearings, and draft out the scheme which can be carried into effect before the lighting services are again in continuous action.

W. J. H.

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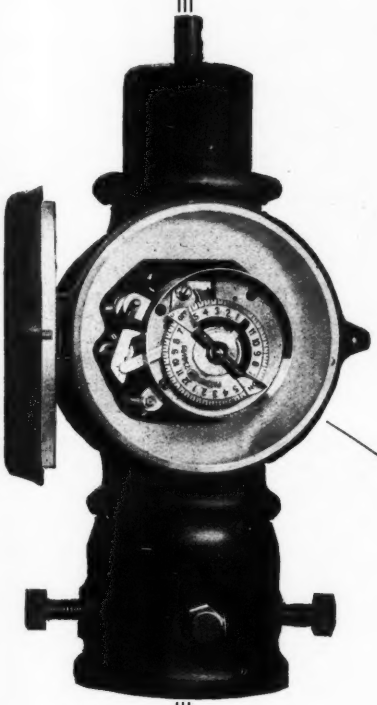

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FIG. 1.—*Night view of a portion of Parade Road, a new thoroughfare leading to the Horse Guards' Parade and the Guards' Memorial. The lighting installation consists of ten octagonal lamps of special design, each fitted with a cluster of sixteen No. 2 size Inverted Incandescent Gas Burners on a single superheater. The lamps are lighted and extinguished by the turning of a cock fitted in the base of each lamp, access to which is obtained by means of a door in the casting. The height of the mantles from the roadway is 22 feet 4 inches, and the distance between the lamps is approximately 270 feet.*

Gas as an Illuminant

Development in the Public Lighting Field

IT is not too well known that out of 670,000 public lamps in Great Britain and Ireland 585,600, or about 87 per cent., are gas, and 84,700, or about 13 per cent., are electric; and this in spite of the fact that during the period of a single lifetime a 90 per cent. lighting load of the gas industry has been transmuted to a 90 per cent. heat and power load.

On the face of it this is a big revolution. But we have to remember that during this period the output of gas has been more than quadrupled by its extended use in new directions. We find, therefore, rather paradoxically, that the *relative* importance of the lighting load has decreased while a considerable part of the load itself has been retained.

In fact, in certain spheres of modern gas lighting it is not sufficient to say that the load has been "retained."

In the lighting of streets, shopping parades, shops and public buildings especially, installations are constantly being made, developed and improved upon. And we can hardly leave out of account—though we would obviously lay special stress on the foregoing—the numerous instances in which gas is nowadays being used for domestic lighting installations in the large housing estates.

Housing Schemes.—At a recent district conference of the British Commercial Gas Association, held at Truro, details were given of the part played by the gas industry in equipping artisans' dwellings with gas for lighting and other purposes. At Truro 200 houses have been erected, each with a gas supply for lighting, and in many cases for cooking and heating. At Falmouth, a model village of 155 houses known as "Swanvale," has been erected for the employees of the Docks Company, and here every house is using gas for lighting, cooking, and in many cases for hot water supply. Falmouth Corporation have also erected 300 houses which are practically all-gas, and the same authority is now embarking upon a fourth scheme of 150 houses.

At Camborne 82 all-gas houses have been fitted, after keen competition with the Electric Company, whilst at St. Austell 170 new houses have been fitted with gas appliances for all purposes.

This is typical of the way things are going all over the country. It is commonly found that modern gas burners and fittings for lighting the dwelling-houses of ordinary consumers provide a form of lighting which is unrivalled for a combination of economy and hygiene. Light, warmth and ventilation are being provided by incandescent gas lighting at an average cost per burner of one penny for five hours.

The figures quoted above are encouraging for the gas industry, but no one would maintain that the domestic lighting load is in any degree comparable with that of public lighting—a field in which the gas industry is enjoying real progress.

Street Lighting.—For lighting with gas at ordinary mains pressure superheater incandescent gas burners, which give as much as 50 per cent. more light per cubic foot of gas consumed than was previously possible, have no superior. The gas and air mixture passes to the burners in a preheated condition, the effect of which is a higher flame temperature and a consequent increase in mantle luminosity. Small mantles, which not only have a longer life than large ones but are more easily brought to a state of full uniform incandescence, produce a remarkably high degree of brilliancy when lit by this method and arranged in "cluster" form, a plan which loses nothing in convenience, since the cluster lamp, whether composed of two or twenty burners, can be adjusted by the turn of a single regulating screw.

The incandescent gas light of to-day is closely akin in colour to daylight, and its fog-penetrating capacity—due mainly to the large area of the actual source of light—is of especial value during the autumn and winter months. One has only to walk (or, better still, to drive a car) on a foggy day through some of London's best-known thoroughfares and neighbourhoods—Victoria Street, Parliament Square, Whitehall, Trafalgar Square, Regent Street and Pall Mall, to mention just a few—to appreciate the wisdom of the local authorities concerned in choosing and retaining gas as the illuminating agent. It may be added that the fine installations in these streets were secured in open competition. The same success awaits efforts made in other districts, even though less brilliant lighting may be required.

Where equal consideration is given, gas for street lighting will *on its merits* hold its own. In the following cities and towns the gas and electric undertakings are municipally owned. *The local lighting authority has, therefore, no object in favouring one or the other illuminant.* The numbers of incandescent gas lamps in their streets speak for themselves.

FIG. 2. — *Kensington Road is lighted by circular Gas Lamps containing five burners using large-size mantles raised about 15 feet above the road level. Street lighting during times of fog calls for special attention on the part of lighting authorities. A point in connection with gas lighting which is worthy of consideration is the fact that it has considerable fog-penetrating powers.*

FIG. 3. — *Street lighting in England is still in many cases inferior in quality and power to that of Continental towns. This cannot be said of the installation of low-pressure gas lamps in Ashley Gardens, Westminster, which is a typical example of the lighting arrangements in many of the well-lighted thoroughfares of the City of Westminster. Note the almost complete absence of shadows in the roadway.*

	Incandescent Gas Lamps
Leicester	6,107
Nottingham	8,287
Birmingham	24,950
Manchester	22,282
Halifax	4,862
Bolton	7,071
Chesterfield	1,003
Bradford	13,097
Coventry	2,095
Huddersfield	4,010
Leeds	16,389
Oldham	6,409
Stoke	4,162

In the above towns only one street lamp in every twenty-three is electric, the remaining twenty-two are gas.

Public Buildings.—Inside lighting presents rather special problems. In all large buildings it is essential, in the interests of health and hygiene, to ensure efficient ventilation.

In buildings which are often closely packed with people, however, it will sometimes be found that the natural ventilating properties of the buildings are inadequate. The large quantity of vitiated air produced will, in course of time, owing to its inability to escape quickly enough, occupy space lower than that at ceiling or roof level, and particularly in the case of buildings with galleries or fairly low ceilings will ultimately descend to breathing level. In lofty buildings in which no special means are employed for heating the walls, windows and ceilings it will often be found, too, that in cold weather the rising currents of warm air become chilled; if, therefore, easy means of escape for the warm air have not been provided these currents will fall, or will at least be prevented from ascending. If they fall a sensation of draught will be experienced—in fact, many of the draughts complained of in lofty buildings are due to this chilling of upward currents and their subsequent descent. This descending air is not suitable for breathing purposes. Even where a somewhat expensive means for heating the walls is adopted, this may not entirely overcome the difficulty unless adequate means of exit for the heated air are provided. Fans, while they undoubtedly carry out the valuable function of keeping the air of the building in movement, have

little ventilating effect, and therefore do not remove the vitiated air unless of course they are connected to an outlet shaft.

The ideal solution of this problem of ventilating in large and medium-sized buildings is a combination of ventilating ceiling gas lights and Tobin tubes or similar devices. Incandescent gas burners, owing to the heat which they give out, create a strong uprush of air, and when fixed at the base of a special shaft communicating with the outer air have a greatly increased ventilating effect. This is the principle on which ventilating gas lights act, while at the same time furnishing an ample well-diffused light from a height which in most circumstances prevents all possibility of eyestrain.

Good Lighting in the Printing Industry

We have recently had an opportunity of examining several of the " Health Leaflets " issued by the Health Committee of the Joint Industrial Council of the Printing Trades. Leaflet No. 10, entitled " Good Lighting of Printing Offices," summarizes some of the chief conclusions arrived at by the Illumination Research Committee working under the Department of Scientific and Industrial Research. This Committee had the benefit of the co-operation of two representatives of the Joint Industrial Council of the Printing and Allied Trades (Mr. A. E. Goodwin and Mr. A. E. Holmes), and we are glad to see that this Council is doing further good service by making the results of this inquiry known to the printing industry. Figures are quoted to show the direct influence of higher illumination on the speed and accuracy of work. Another leaflet (No. 11), prepared by Mr. W. G. Barker, Past President of the British Optical Association, emphasizes the drawbacks of defective eyesight. Reports of examinations conducted on behalf of two leading firms, Messrs. Morland & Impey, of Birmingham, and Messrs. Hazell, Watson & Viney, of Aylesbury, show that respectively 37 and 64 per cent. of employees needed glasses or revised prescriptions. These high figures indicate the importance of attention to the eyesight of those in the printing industry. On previous occasions we have emphasized the importance of this matter to the illuminating engineer, for an operator who suffers from defective eyesight is apt to blame the lighting for trouble which may in reality be due to his vision not being normal.

A Holophane Conference

A Conference of Municipal Electrical Engineers was held at the headquarters of Holophane Ltd., on July 17th. There was a good attendance, and much interest was shown in the various papers, which were read by members of the Holophane staff. Particular interest was shown in the latest Holophane developments in street lighting, colour lighting, and the manufacture of high-grade illuminating glassware.

In the evening the company assembled at Dinner at the Criterion Restaurant, under the chairmanship of Lord Ernest Hamilton, the Chairman of Directors of Holophane Ltd. The subsequent proceedings were enlivened by professional artistes, and an instructive and informative day finished on a high note of cordiality and friendship.

Sheffield Illumination Society

Favoured with ideal weather conditions, about 70 members and friends travelled to Edwinstowe on Saturday, the 23rd June, for their annual excursion.

The party left the Lighting Department at 8-30 a.m., and the scenery of the Dukeries was much enjoyed.

Cricket was the order of the day, and Sherwood Forest proved a very suitable place both for this game and others. A point of interest in the forest was, of course, the " Major Oak," and we were given to understand that this fine tree is about 1,500 years of age, 35 feet circumference of the trunk, 100 yards circumference of the branches, and is capable of accommodating from 12 to 18 persons inside the trunk. According to legend, Robin Hood was closely associated with this remarkable tree.

After tea at Edwinstowe the party left at 6 p.m., having had a most enjoyable and successful outing.

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The following contracts are announced :—

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Royal Mail Steam Packet Co.; for twelve months' supply of Siemens gasfilled, vacuum and carbon-filament lamps.

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TRADE NOTES & ANNOUNCEMENTS

LIGHTING AT ALDERSHOT SEARCHLIGHT TATTOO.

For many years past the Aldershot Searchlight Tattoo has been regarded as one of the most striking lighting spectacles of the year, and the recently concluded 1928 Tattoo was no exception. Many of the settings were bathed in beams of multi-coloured lighting from the military searchlights, a number of which were equipped with G.E.C. colour mediums for the presentation of kaleidoscopic colour effects.

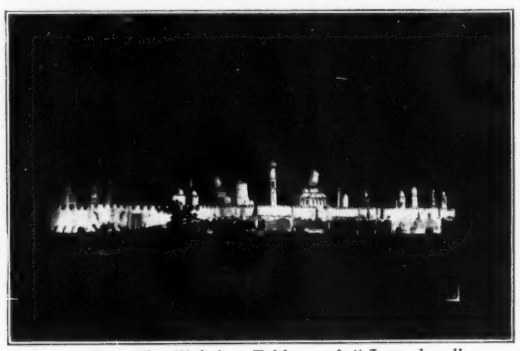

FIG. 1.—This Floodlighting Tableau of "Jerusalem" was illuminated by G.E.C. Projectors.

In the presentation of the origin of the beating of "Tattoo"—first introduced by William of Orange—an illuminated castle played an important part. Probably, however, the vision of "Jerusalem the Golden," staged during the presentation of "The Crusaders," was even more effective. Situated upwards of a mile from the grandstand, "Jerusalem" was silhouetted against the darkness, with its temples and towers flooded by a sea of soft golden light from powerful batteries of hidden G.E.C. projectors equipped with Osram gasfilled lamps. This vision lasted little longer than 20 seconds; it is shown above in Fig. 1. Later the city was destroyed by fire, and the floodlights illuminated the ruins as the dense clouds of smoke poured aloft, the spectacle revealing a lurid smoking inferno of desolation and destruction. This is shown in Fig. 2.

During these tense moments a great "fiery cross" appeared in the distant blackness high up in the heavens. This cross was some 30 feet high by 20 feet wide, and, constructed of steel tubing and G.E.C. fairyland strip, was equipped with Osram 20-watt sign-type lamps and mounted on top of the flagstaff on Government House.

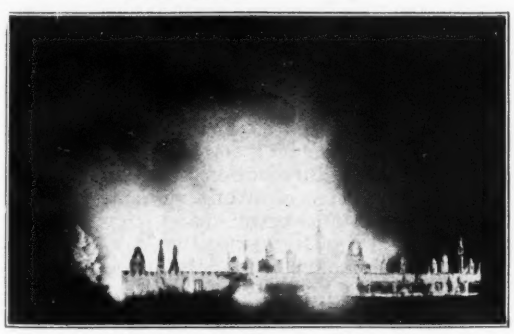

FIG. 2.—"Jerusalem" in Flames. Illumination is by G.E.C. Floodlights.

Another striking feature of the Tattoo was the reproduction of a field of Flanders poppies. This patch of crimson red, consisting of real Haig poppies with stiffened stems (made in the Earl Haig factories), with its whited cross, was revealed after the battle of the Menin Gate with "Lest we forget" standing out in illuminated letters in the background. The poppy field was illuminated on novel lines by a series of V-shaped battens let into trenches in the ground. These were equipped with Osram lamps, while a battery of G.E.C. floodlights concealed in the rough undergrowth aided the illumination of the setting. Each letter of "Lest we forget" was illuminated by Osram sign-type lamps.

This impressive scene was originated by Captain A. J. Mayne, M.I.E.E., Chief Electrical Engineer of the Aldershot Command.

The electro-mechanical installations were entrusted to Messrs. Burch & Virtue, of Union Street, Aldershot, who also manufactured the torches.

As usual, large numbers of Wembley lanterns were employed in connection with the very elaborate motor-car parking arrangements, the general lighting being supplemented by a system of coloured lighting parking indicator units.

DIFFUSING GLASSWARE.

In the course of a recent visit to Messrs. Regents Limited (Shepherd's Bush Green), we had an opportunity of seeing some of the latest forms of glassware now being introduced by this firm. These enclosed diffusing units are executed in pleasing designs, a feature of the latest type being the design of the lower section of the fitting, which is in the form of a complete hemisphere.

One of the smaller "Regant" Fittings.

The chief point of interest in regard to these fittings, however, is the special quality of the glass. This is of the three-ply type, the thin layer of white glass in the centre being protected by clear glass on either side. We were shown samples of this glass, and were struck by the colourless nature of the transparent glass, which seemed to be quite free from the slight green tint so often caused by traces of iron. Viewed by daylight this glassware appears to have a slightly bluish tint. The result of this is seen by artificial light when the light emerging from these fittings is distinctly "whiter" than that from ordinary opal glass bowls. The distribution of brightness over the surface of the glassware is very uniform, and no image of the filament is visible. It was explained that one of the main features of this glassware is the manner in which both extremities of the spectrum, i.e., in the red and the blue, are intensified, and this is stated to have an important influence on the appearance of coloured objects when illuminated by these units.

It was also interesting to learn that this form of glass is now being supplied in the form of panels and "artificial ceilings," etc., for decorative interior lighting. We understood that such panels are already being installed in several of the leading London stores, and we hope shortly to be able to give particulars of some such installations.

A NEW 100-WATT GASFILLED LAMP.

We notice that the British Thomson-Houston Co. Ltd. is drawing the attention of users to the fact that the dimensions of the 100-watt gasfilled lamps have recently been altered in accordance with new standards. The use of the new pattern lamp, which is now on the market, will affect the lighting efficiency of existing installations employing shop-window or industrial reflectors such as the B.T.H. X-Ray, Mazdalux and other types, owing to the change in the position of the filament in relation to the contour of such reflectors.

In order to overcome this difficulty the British Thomson-Houston Co. Ltd. has produced, and will supply free of charge, suitable galleries or adapters which will afford the necessary correction.

The Illuminating Engineer

The Journal of

GOOD LIGHTING

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Proofs to be passed by the 20th of the month. In the event of proofs not being passed by this date it will be assumed that matter is repeated.

SPECIAL INFORMATION.

THE ILLUMINATING ENGINEER (the Journal of GOOD LIGHTING) was founded in January, 1908, and has thus been in existence for twenty years.

SINCE the year 1909, when the Illuminating Engineering Society was founded in London, it has been the official organ of the Society.

IT is *the only journal in this country exclusively devoted to Lighting by all Illuminants.*

IT receives the assistance of contributors who are leading experts on illumination in this country and abroad. Foreign Notes and News will be a speciality, and correspondents have been appointed in all the chief cities of the world.

THE Journal contains *first-hand and authoritative information on all aspects of lighting;* it has also been improved and extended by the inclusion of a *Popular and Trade Section* containing special articles of interest to contractors, gas and electric supply companies, Government Departments and members of the Public.

DISCUSSIONS before the Illuminating Engineering Society which are reproduced in this Journal are participated in alike by experts on illumination and *users of light*, whose co-operation is specially invited.

Good Lighting is of interest to everyone. The Journal is read by engineers, architects, medical men, factory inspectors, managers of factories, educational authorities, public lighting authorities, and large users of light of all kinds.

BESIDES being issued to all members of the Illuminating Engineering Society, the Journal has an independent circulation amongst people interested in lighting in all parts of the world. The new and extended form of the Journal should result in a continual and rapid increase in circulation.

Every reader of THE ILLUMINATING ENGINEER, the Journal of GOOD LIGHTING, *is interested in illumination, and is a possible purchaser of lamps and lighting appliances. Gas and Electricity Supply Undertakings likewise benefit by the movement for Better Lighting, with which the Journal is associated, and which stimulates the demand for all illuminants.*

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The Society preserves an impartial platform for the discussion of all illuminants, and invites the co-operation both of experts on illumination and users of light; it includes amongst its members manufacturers, representatives of gas and electric supply companies, architects, medical men, factory inspectors, municipal officers, and many others interested in the use of light in the service of mankind.

The Centre for Information on Illumination.

For particulars apply to:

J. STEWART DOW, *Hon. Secretary*, 32, Victoria Street, LONDON, S.W.1.